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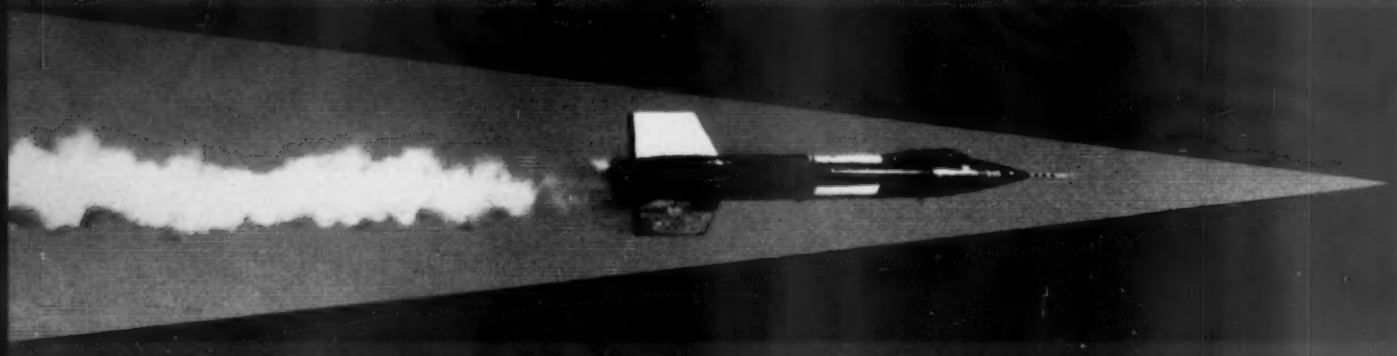

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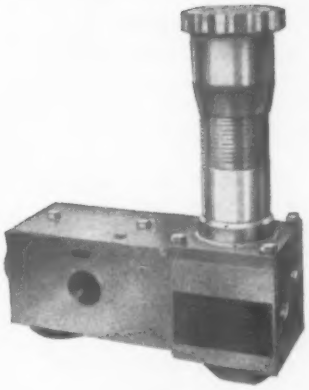

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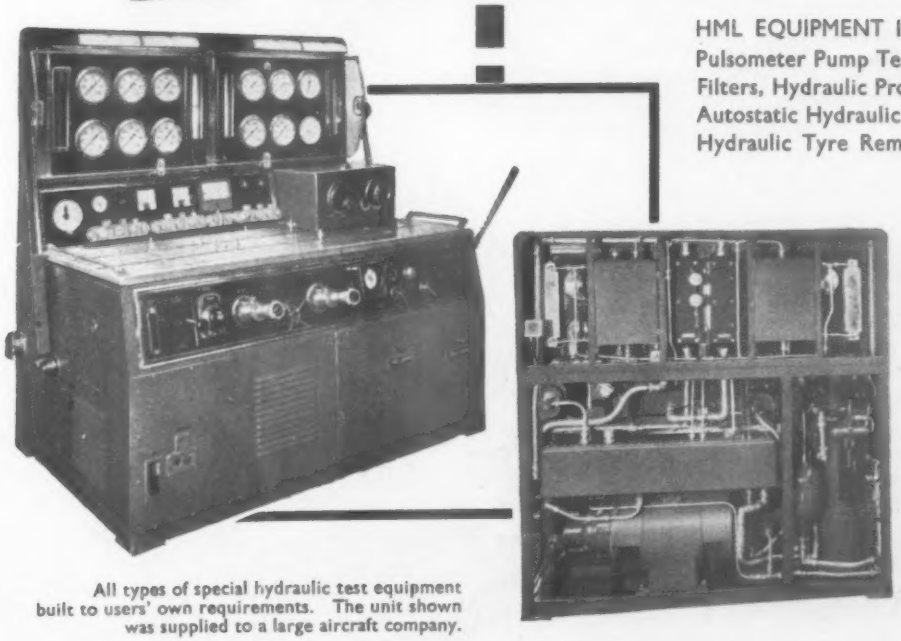

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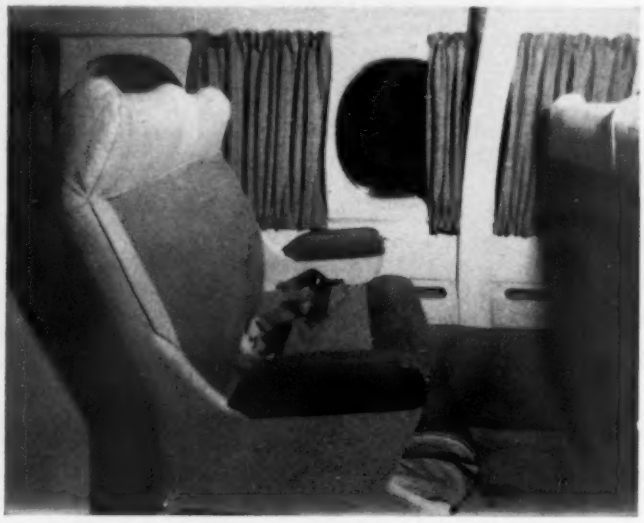

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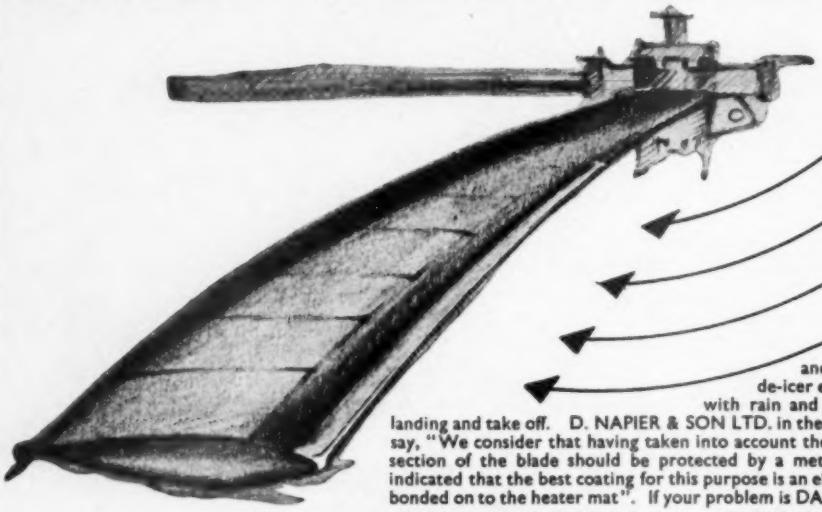

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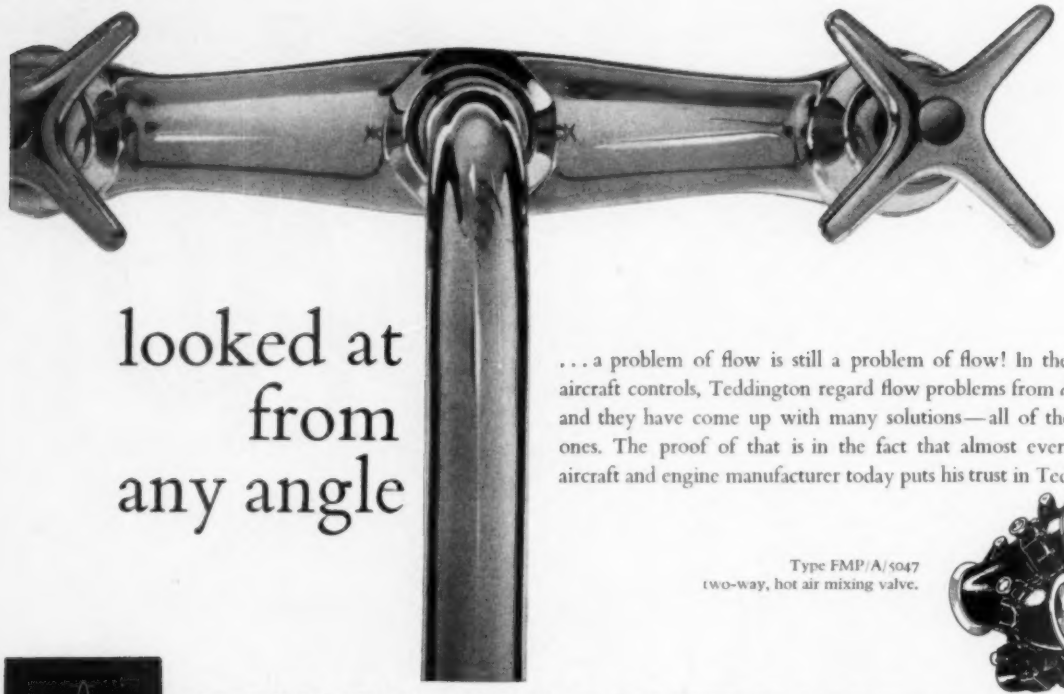

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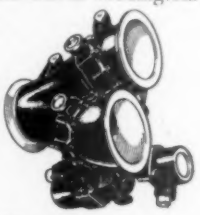

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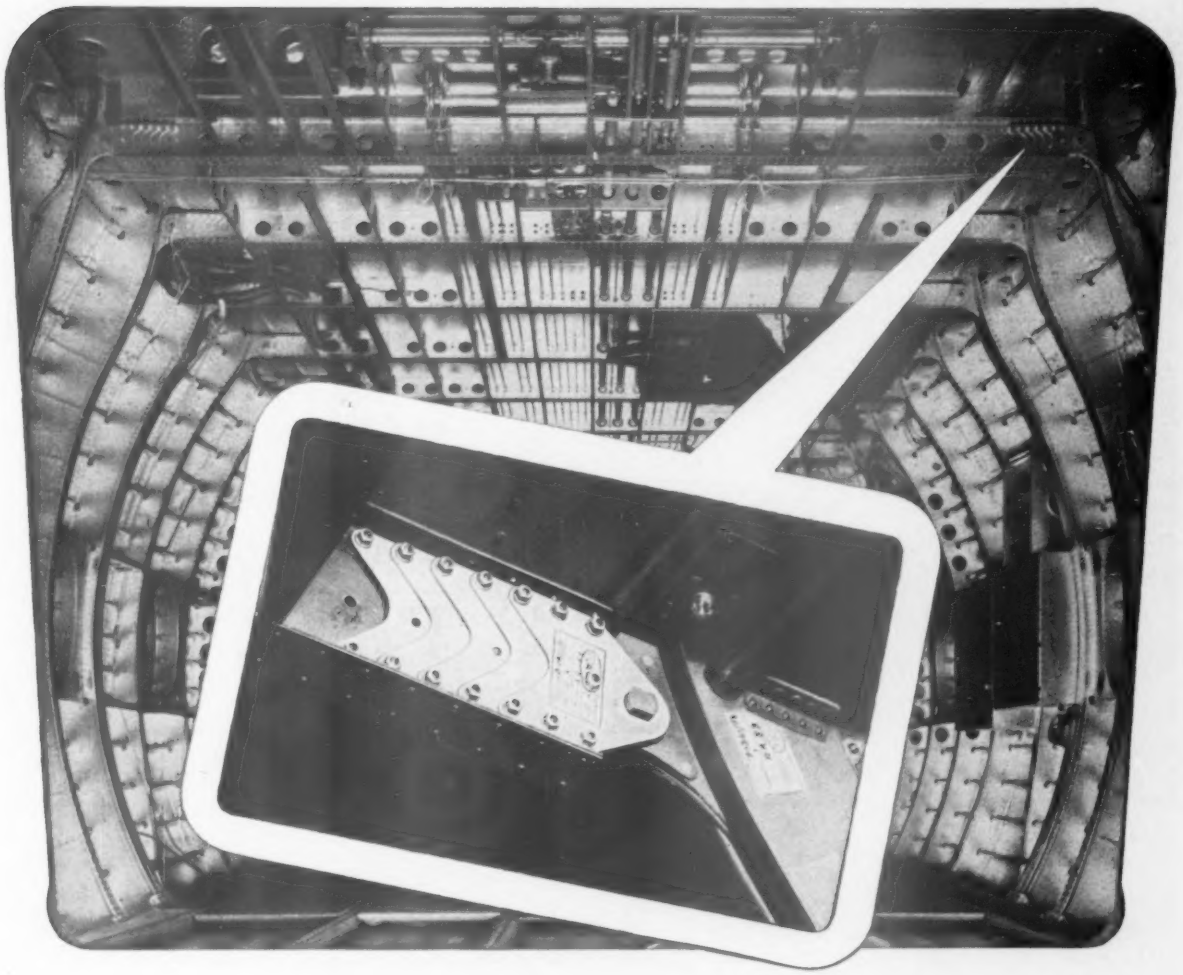

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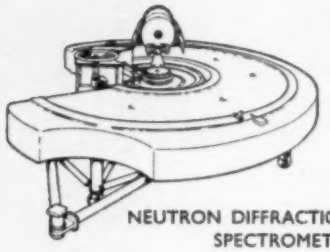

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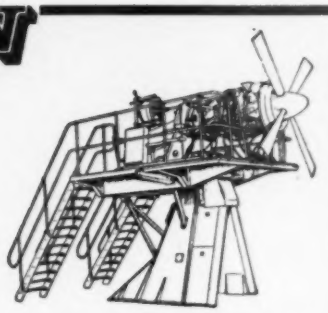

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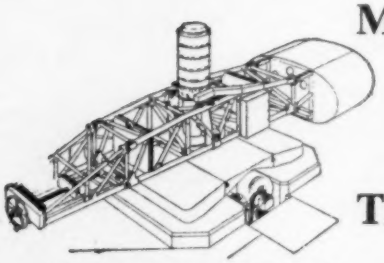

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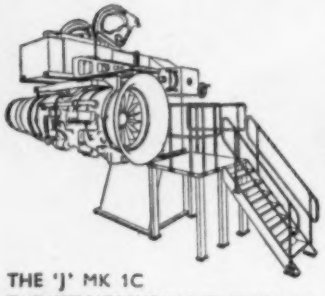

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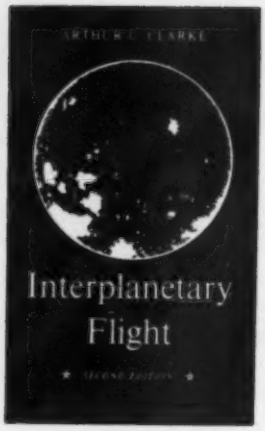

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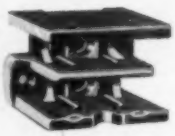

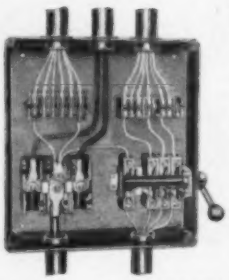

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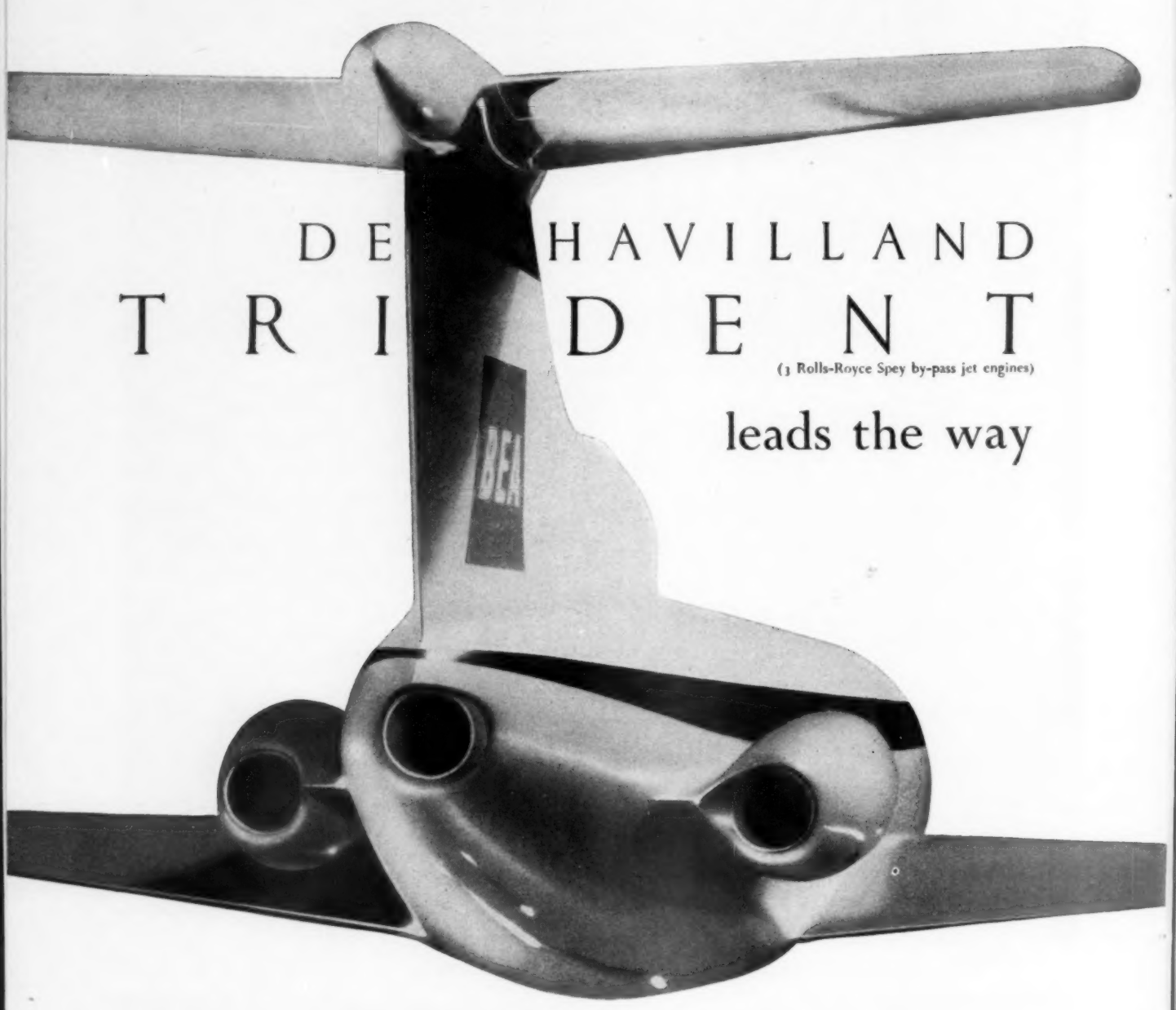

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Hawker Siddeley Aviation is the force behind this world-market project

THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2582 APRIL 13, 1961

STOL as a Bonus

Once again emphasis has been publicly laid upon the irony of the situation where the aircraft industry has demonstrated its ability to provide practical aircraft able to take-off and alight without horizontal motion, yet neither the Defence Services of the World nor the air transport operators show any conspicuous enthusiasm for what one might reasonably have expected to be accepted as the most important development in aeronautics since the appearance of the Wright "Flyer." On this occasion the observations were made by Mr. H. G. Conway, lecturing in New York last week. As deputy managing director of Short Brothers and Harland, the firm that have produced the flat-rising SC-1, he must find the situation hard to endure.

We wish to give as much emphasis as we can to another remark made by Mr. Conway. He was at pains to put forward the view that the feature which the military should exploit is true VTOL. "STOL capability," he said, "should be available only as a bonus." This view, we are certain, must be accepted by all who have a true understanding of the potentiality of the new development. It can only prove short-sighted to argue that because the development of engines adequate for the practical utilization is going to take some time, it would be more beneficial to spend our present efforts on STOL. Fail to develop the potentialities of VTOL then STOL will not be available as a bonus but only as the outcome of specific design.

As illustration let us say that a VTOL supersonic fighter could be carried by, and be launched from, and return aboard, a submarine. If the necessary wing-folding and need for a watertight hangar make the possibility too expensive—the same class of aircraft could be operated from the Navy's smallest ship. And to give topical atmosphere to a VTOL civil transport, we could have the airliners operating from the car parks, thus freeing the rest of London Airport for the travellers' motorcars!

Graduates for Maintenance

A problem that is occupying the attention of those who have the future of our air transport industry at heart is how to attract university trained engineers to the maintenance and engineering sides. At present in the airline corporations it is not possible to offer engineering graduates employment in the maintenance and inspection branches. It is not possible for undergraduates to be employed during their long vacation in these branches. This is because such applicants would not have the necessary union qualifications.

It seems worth while airing this problem in this particular issue since it is devoted to an analysis of the characteristics of the wide variety of aircraft used in the international business of air transport. Anyone who studies it closely will be left in no doubt about the technical complexity of the craft now in use. In the view of those best qualified to know there are not enough graduate engineers employed in the development sections of the corporations to deal with the problems arising from increased complexity.

In such circumstances one would have thought that ways could have been worked out of utilizing the "sandwich" type of training now so popular in the engineering business. In this, young men qualifying as craftsmen through appropriate terms of service in the shops, sandwich their practical experience with courses at the University.

It would seem that it is in this direction that the corporations could usefully start a foray.

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Matters of Moment

The VTO Dilemma

"TECHNIQUES are now ahead of staff thinking and requirements." This, asserts Mr. H. G. Conway, M.A., F.R.Ae.S., M.I.Mech.E., deputy managing director and chief engineer of Short Bros. and Harland, Ltd., is the dilemma facing designers of VTOL aircraft at the present time. He was addressing the National Aeronautic Meeting of America's S.A.E. in New York on Apr. 4.

This situation, he added, was nothing new in itself and had often happened with elements of an aeroplane or its equipment. "What is new, perhaps, is that a complete aircraft system has been developed before there is a clear-cut requirement for it. To many Air Force, Army and Naval officers in several countries we have said—'Here you are: what are you going to do with it?' And the truth is that they don't yet really know."

"We feel," he said, "that the feature which the military should exploit is true VTOL, and STOL capability should be available only as a bonus, for example, for ferrying. Only true VTO will give real independence of runways, or prepared ground, and complete tactical freedom. STOL has always been available in the form of catapults or other acceleration and deceleration devices, but has never been used in practice. Even a few hundred yards of clear ground implies some sort of aerodrome. And please do not at this stage in the art, make too much of the need for ground platforms or equipment.

"We feel that the development of low-level strike aircraft, with a true VTO capability could put a powerful tool in the hands of the Air Force, Army and Navy. Perhaps for the first time the same aicraft can be suitable to all three Services without alteration. The same aircraft can be operated at sea and on land—something which must be significant. Surely flexibility of operation can compensate for loss of range.

"Supersonic transport aircraft with VTO should be developed. The benefits which independence of conventional airfields, the prospects of making safe all-weather operation feasible and the reduction in urban disturbance which a single operating direction ignoring wind direction can introduce, must be tremendously significant and will offset to some extent any performance penalty which the VTO solution introduces with the present state of the art. As techniques develop these penalties should become smaller or can disappear.

"Whether we should now proceed to develop conventional supersonic airliners before the airlines have got round to making their ordinary jets pay is a point for debate. It might be argued that we would be wiser to put off the day of the supersonic airliner a little, skipping the conventional phase and going straight to VTO all-weather phase which some of us dream about. In any event, a military VTO transport is a desirable first step."

Photograph copyright "The Aeroplane and Astronautics"

EXECUTIVE OCCASION.—Mr. F. Errol, Minister of State, Board of Trade (left) sets off from Kidlington on Apr. 5 in company with Mr. M. A. H. Bellhouse (centre) and Mr. J. R. Edwards, to visit the Pressed Steel Company's factory at Swansea and the Beagle headquarters at Shoreham.

INDIAN AIR FORCE ANNIVERSARY.—Gp. Capt. Moolgavkar and Mde. Moolgavkar greeting A.V.M. E. N. Lowe, director-general of equipment, Air Ministry, on Apr. 5. Below, Sir Frederick Handley Page, Mr. D. N. Kaul, deputy High Commissioner, A.C.M. Sir Harry Broadhurst, managing director A. V. Roe, Ltd., and A.C.M. Sir Edmund Huddleston, Vice-Chief of the Air Staff.

French Aircraft at Paris

SEVERAL new French aircraft will be seen for the first time in the flying display of the Paris Aero Show during the week-end of Jne. 3-4, and others will be exhibited on the ground during the whole period of the exhibition, from May 26. The newcomers in the flying programme will include the Breguet 941 STOL transport, the Dassault Avon-Mirage, the M.S. 885 Super-Rallye, the Potez 840, the Sud Alouette III and S.A. 3200 Frelon helicopters, the S.F.E.R.M.A. Nord 1100 and Beech Marquis, powered with Astazou turboprops, with perhaps the turboprop Do 27 in addition, and the Scintex Rubis and Gardan G.Y.80 four-seat light aircraft.

The full list of French exhibits will comprise (*indicates ground display only):—

Prototypes of Breguet Br. 940, 941, full-scale mock-ups of Br. 941* and 942*, Br. 1050 Alize in Indian Navy colours, Br 905 and 906 sailplanes; Dassault Mirage IIIC interceptor, Etendard IVP*, MD 415 Communaute, Mirage IV-01, Mirage IIIO in R.A.A.F. markings; Hurel-Dubois H.D.34*; Morane-Saulnier M.S.760 Paris II, M.S.880 Rallye-Club, M.S.885 Super-Rallye; Nord M.H. Super Broussard, N. 1500 Griffon, N. 3400*, N. 3202*, C.T.20* and C.T.41* jet targets; Potez 840, C.M.170 Magister II, Heinkel C.M. 191*, C.M. 170 (Bertin silencer); S.I.P.A. 272 twin-Astazou transport mock-up*; Sud Alouette III, S.A. 3200 Frelon, S.A.3210 full-scale mock-up*; United Airlines Caravelle, Santa Maria Caravelle of General Electric; S.F.E.R.M.A. Nord-Astazou, Beech Marquis, Dornier Do 27-Astazou; Scintex M.L. 145 Rubis; Wassmer W.A.40 Super IV, Gardan G.Y.80 Horizon; S.A.N. Ambassadeur; Jodel D.120; Piel C.P.301C.

Forward Planning in the U.S.A.

TWO so-called "task forces" have been set up through the U.S. Federal Aviation Agency at the direction of President Kennedy. One, known as Project Horizon, will study and recommend on overall aviation requirements for the next decade: the other, Project Beacon, will look specifically into air traffic control planning for the future.

The team for Project Horizon is headed by Fred M. Glass, executive vice-president of the Empire State Building Corporation, and previously named as a likely president of T.W.A. The five-man force includes Gerald A. Busch, Lockheed's corporate director of marketing planning.

The seven-man group looking after Project Beacon is headed

by Richard R. Hough, vice-president, operations, of the Ohio Bell Telephone Company. His team includes William Littlewood, vice-president, equipment research, American Airlines.

Project Horizon is intended to define the technical, economic and military objectives which must be aimed at by the Government. It will investigate the development of the military, general aviation and air transport markets in the 1960s, study the investments necessary for airports and aircraft, and consider the contributions which civil aviation can make to the country's economic growth and military strength.

Project Beacon is designed as a means of planning an orderly and economic evolution of the present A.T.C. system and developing a well-conceived system for managing air traffic.

An Air Ferry Project

ARMSTRONG WHITWORTH AIRCRAFT published details yesterday of the latest variant in the Argosy family, designed for vehicle ferry and "airbus" operations. It is a revision of the earlier AW670 version, taking advantage of developments in the basic AW650 airframe.

With the Argosy wing and tail unit, the AW670 has a new double-deck fuselage, which has a lower hold measuring 58 ft. by 15 ft. by 7 ft. 1 in.; the overhang in the front and rear clamshell doors increases the available hold length to 61 ft. 10 in. for car ferrying. This is sufficient for up to eight cars in two rows; using the fuselage sides as a reference, these could be driven "straight on—straight off," in opposite directions, so that the drivers' doors open on to the gangways near the fuselage sides.

Aft of the wing, the height of the main hold is 9 ft. 2 in. and the rear door aperture is 8 ft. 6 in. high so that most types of touring caravan could be accommodated. In the ferry version,

provision would be made for up to 32 passengers on the forward upper deck behind the flight deck. For airbus operations, 114 passengers could be carried.

Armstrong Whitworth have suggested that the main undercarriage legs should be fixed and faired for ferry operations, to simplify maintenance, but would be retractable in the airbus. The nosewheel would be fixed and faired in either case. With refuelling points on the main legs, the AW670 would have turn-round times of as little as 10 minutes on cross-Channel operations, when complete refuelling would not be required. The vehicle ferry would carry a 25,000-lb. payload for 140 naut. miles or 20,000 lb. for 420 naut. miles while the airbus would carry 20,000 lb. for 350 naut. miles, in all cases with normal reserves.

United and Capital

ON Apl. 4 the U.S. Civil Aeronautics Board gave official permission for the long-planned proposal for United Air Lines to take over Capital Airlines. Integration of the management and operations will begin on Jne. 1 and the combined organization, which will continue to operate under the name of United Air Lines, will be the biggest among the U.S. domestic carriers.

The merger plans were initiated following the threat of a foreclosure by Vickers-Armstrongs, to whom Capital owed about £12 million for Viscount aircraft and spares. Of Capital's earlier fleet of 56 Viscounts, 15 have been returned to Vickers and eight have been resold. The remaining 41 will be temporarily retained by United, but will eventually be sold and replaced by Caravelles and Boeing 727s. Vickers will realize about 74% of the total value of the debt as a result of the sale of the 15 Viscounts and an agreed payment in United stocks and shares.

The merger, now almost certain, means that United will probably take up its option on 20 additional Boeing 727s, making 40 in all. United already has 20 Caravelle VI Rs on order, with deliveries starting this spring; it is unlikely that its option on 20 more Caravelles will be taken up in view of the 727 purchase. During the interim period Capital has been operating two Boeing 720s on lease from United.

The C.A.B. said that the merger was "consistent with the public interest and will not result in creating a monopoly and thereby restrain competition or jeopardize another air carrier not a party to the merger agreement." The approval is subject to rate-making, accounting and labour-protective conditions and to restrictions protecting local-service carriers in the areas served—Mohawk Airlines and Allegheny Airlines. The merger decision will finally become effective early in May, after a 30-day period during 20 of which other airlines may still file objections. With the exception of some top executives, all of Capital's 7,800 employees will be absorbed.

Conway Reliability

TRANS-CANADA Air Lines' initial experience with the Rolls-Royce Conway has been most satisfactory. During the first 31,000 engine hours flown there were 12 in-flight shutdowns, or a rate of 0.387 shutdowns per 1,000 engine hours. This compares with 0.69 for the Wright Turbo-Compound, 0.46 for the Rolls-Royce Merlin and 0.076 for the Dart during the same nine-month period. It must be remembered that the figure for the Conway covers the introductory period for a new engine, whereas the others are for developed powerplants.

The introduction of noise-abatement take-off procedures produced an unexpected bonus in the form of improved turbine-blade life. Douglas had recommended the application of take-off power for 1 min. 50 sec. on the DC-8 before reducing thrust on the climb. For the 707 Boeing recommended take-off power for approximately one minute. T.C.A. has found that Conway turbine-blade life is directly dependent on the time spent at take-off power and has reduced engine time at take-off power to approximately 45 seconds.

It might be thought that by halving the engine-running time at take-off power the problem would only be postponed—that

Howard Levy photograph

NATO COMMON MARKET.—One of two Fiat G-91Rs—powered by Bristol Orpheus turbojets—which are being evaluated by the U.S. Army at Fort Rucker as tactical support aircraft for operation from unprepared strips. This version has a camera nose and a 30-mm. gun on each side of the intake.

Matters of Moment . . . .

failures would again occur after twice as many take-offs. In fact, blade life depends upon the temperature to which the blade is subjected at take-off. With Conway air-cooled blades, the maximum gas temperature allowed is not reached during the 45 seconds of running at take-off power.

During 73,172 hours of Conway operation in Boeing 707s, three turbine-blade failures occurred, whereas in 30,176 hours of Conway operation in DC-8s there were four failures. A comparison of the Boeing rate of 0.041 per 1,000 hr. with the 0.133 per 1,000 hr. for the DC-8 clearly shows the benefit of shorter take-off power times.

Two sets of Nimonic 105 blades, which proved so successful in the Dart, are now flying in T.C.A.'s DC-8s and the remainder of the fleet is also to have these blades.—N.A.M.

IATA's Supersonic Symposium

NEXT Monday, Apr. 17, in Montreal, the International Air Transport Association opens its 14th technical conference —which is of very special interest and importance because the main item will be a symposium on the supersonic transport aircraft.

Mr. R. V. Carleton, vice-president, operations, Braniff International Airways, will be chairman of the conference as a whole, and Mr. J. T. Dyment, director of engineering, Trans-Canada Air Lines, will preside over the symposium, with Mr. Clifford H. Jackson, of B.O.A.C., as its vice-chairman.

There will be three special working groups for the symposium —covering aircraft design, operations and ground handling. The conference is expected to attract more than 500 aviation specialists and economists from airlines, manufacturers, governments and air forces.

New U.S.A.F. Systems Command

TO ensure that the development and purchasing of advanced weapons and space projects comes under a single authority, the United States Air Force is setting up a new Systems Command from Jly. 1. It will be responsible for weapons from the time their development begins until their operational deployment.

In the past the responsibility for development and purchasing has been divided between Air Research and Development Command and Air Materiel Command. In effect, the new Systems Command will consist of ARDC with the addition of AMC's procurement and production responsibilities. The remainder of AMC will be renamed Air Force Logistics Command and will provide logistic support for the U.S.A.F.

The setting up of the new Systems Command represents a triumph for Lt.-Gen. Bernard Schriever, who will be its commander; at present he is the head of ARDC. In the past he had advocated an organization of this type. He believes that weapon systems must be developed using the "concurrency" concept, in which all their elements advance in parallel according to a single plan.

Criticism of delays and divided responsibilities in the construction of ICBM sites has also been a factor leading to the creation of the new command. The decision to give the U.S.A.F. sole responsibility for developing military space systems has also played a part.

The Systems Command will have two major divisions at Inglewood, California, which will be responsible for ballistic and space systems respectively. Its two other major divisions will be responsible for aeronautical and electronic systems; they will be based at Wright-Patterson A.F.B., Ohio, and Hanscom A.F.B., Mass., respectively. The command will also be responsible for the test centres at Edwards A.F.B., Holloman A.F.B., Kirtland A.F.B., Patrick A.F.B. (Cape Canaveral), Eglin A.F.B., and Tullahoma.

The current ARDC-AMC organization has produced rapid results by British standards, particularly in developing such missiles as the Thor. But visitors to Inglewood have been puzzled about the respective rôles of the ARDC and AMC organizations responsible for ballistic-missile development and deployment. The new arrangement is obviously much tidier and more logical; there will be no doubt about responsibilities if missile bases fall behind schedule in future.

As already stated, the Systems Command is effectively ARDC with considerably greater power and responsibilities. But ARDC has lost one of its previous functions, the responsibility for basic research and certain applied research. This will come under a new Office of Aero-space Research reporting direct to the U.S.A.F. chief of staff.

HAPPIEST DAY.—Mr. Oswald Short, only survivor of the three Short brothers, speaking at Pembroke on the occasion of the inauguration of the Sunderland flying-boat memorial (reported last week). He said it was "the happiest day of my life."

Many Newcomers at Baginton

IN the finalized list of light and executive aircraft scheduled to appear at the Shackleton Sales Week-end at Baginton, Coventry, from Apr. 28-30, which includes 45 completely different new aeroplanes, are the first products of the Beagle/Auster company. The Beagle/Auster Airedale is to make its first appearance in public at Baginton, and coincident with this announcement from W. S. Shackleton (Aviation), Ltd., has come the registration of the Beagle/Auster A.109-X and -Y, G-ARKE and 'KF in the March A.R.B. Register.

Other newcomers will be the Beech Baron and Queen Air, the four-seat Bolkow F.207, the Dornier Do 28, the Grumman Gulfstream, the Lockheed LASA 60 Santa Maria, the Piper Cherokee and the Pawnee.

The full list of types booked to appear comprises: Aero Commander 560F, Aeromere Falco, Aircoupe Executa, Avro 748 (fly-past only), Beagle/Auster AOP 6 development, Beagle/Auster Airedale, Beechcraft Baron, Bonanza, Debonair, Queen Air, Travel Air, Bolkow F.207, Bolkow-Klemm Kl 107C, Cessna 150, 172A/Skyhawk, 175A/Skylark, 180C, 182C/Skylane, 210, 310F, Champion Tri-Traveler, D.H. Dove Mk. 8, D.H. Heron, Dornier Do. 27, Do. 28, Fokker Friendship, Grumman Gulfstream, Jodel Ambassadeur, Mousquetaire, L.A.C. Propector, Lockheed LASA 60, Miles Student, Omnipol Aero 145, Meta-Sokol, Morava L.200A, Piaggio P.166, Piper Apache, Aztec, Cherokee, Colt, Comanche, Pawnee, Super Cub, Tri-Pacer, Rhein-Flugzeugbau RW-3, Tipsy Nipper.

The airfield will be open each day between 11.00-18.00 hr., and admission fee to the public enclosure will be 2s. 6d. (1s. for children). In addition to the static display of new and used aircraft, which will be visible from the public enclosure, individual flights to potential customers will go on throughout each day. Pleasure flying facilities will be available. During each afternoon there will be a period of demonstration flying.

United Steel Airstrip

A FURTHER landmark in the development of executive flying in Great Britain will arise from the purchase by the United Steel Companies, Ltd., of 108 acres of land near Coal Aston, Sheffield, for development as an 800-yd. airstrip for the company's aircraft. The strip will be some 15 minutes away by car from United Steel's head office; it is scheduled for completion in the early summer.

United Steel purchased its first executive aircraft, a Piper Apache, in July, 1958. Having established the value of this means of transport for conveying customers and senior executives between the company's principal branches in Sheffield, Scunthorpe and Workington and to other parts of the country, United Steel bought a Piaggio P.166 six-seater twin last summer. Both aircraft, with their two pilots, are currently based at Ringway, Manchester.

Anglo-American VTO Co-operation

AN outward and visible sign that the Hawker Siddeley Group keeps a constant and close watch on the possibilities of active technical co-operation with American companies was given earlier this week by a report that an offer for the Hawker 1127 had been made by Republic Aviation. It was said that the American company wanted to take over the VTO "secrets" of the 1127 and build them into an aircraft of American design to be produced on a massive scale in the United States and on a subsidiary line in the United Kingdom. This, it was suggested, was just the sort of U.K./U.S. co-operation agreed by the Prime Minister and the President in their recent talks.

However, while this particular technical exchange may, in the long run, very well be a mutually advantageous step to take, it is not likely to be as imminent as the report might be taken to suggest. For one thing, the 1127—unique and advanced though it is—is still in a very early stage of its development. At the present time any talks on the line suggested can only be of a very preliminary nature. More positive ones are not likely to be made before the aircraft is fully developed. Meantime, the Hawker Siddeley Group will doubtless continue to keep in close touch with developments on the other side of the Atlantic and to maintain its discussions with a number of interested American companies concerning all its projects.

South American Agreement

SABENA, whose present airline interests do not extend into Latin America beyond Mexico City, has acquired a 30% interest in Transcontinental S.A., Argentina's privately owned long-haul carrier. T.S.A. started Buenos Aires-New York services in September, 1958, with L-1049Hs and now operates Britannia 308s over this route.

T.S.A. shares Sabena's passenger and other facilities at New York International and the two operators have come to an agreement whereby Sabena handles T.S.A.'s business elsewhere than in South America, where T.S.A. will look after Sabena's interests.

According to *Aviation Week*, T.S.A. expects to be operating turbojets—probably 707-320s leased from Sabena—on the B.A.-New York route within the next few months.

Mr. W. J. Andrews

WE regret to record the sudden death on Apr. 3 of Mr. W. J. Andrews, chief engineer of the College of Air Training at Hamble. He was 62 years of age.

After serving in the R.N.A.S. during the First World War, he saw the early development of Australia's internal air routes for, in the early '20s, he was concerned with aircraft maintenance at Broken Hill.

Prior to joining the College of Air Training when it was formed in May of last year, Mr. Andrews had been in charge of the aircraft maintenance at Air Service Training, Ltd., for over 30 years. During this time he served at the A.S.T. School, Watchfield, and assisted in the setting up of a training establishment for the Pakistan Government at Mauripur.

Mr. Andrews was an active member of the Southampton Branch of the Royal Aeronautical Society, and of the Society of Licensed Aircraft Engineers.

£20 Million Lost on Electras

ALTHOUGH the theme of Lockheed's annual report for 1960 (released last week) is one of optimism for the future, it makes quite clear that the company has been passing through a very tough time. In fact, 1960 was the first year since 1947 in which a net loss was recorded, and this can be attributed largely to the cost of writing off the development and other special costs associated with the Electra and the JetStar. In mid-1960, Lockheed wrote off $67.6 million (after taxes), including the entire past and forecast future costs of the Electra modification programme, and anticipated losses on both the Electra and the JetStar.

At the mid-year point, the company showed a net loss of $55.4 million. This was reduced to a figure of $42.9 million for the year by profitable operation in the second half; by comparison, an $8.7 million profit was recorded in 1959. Total sales in 1960 were $1.332 million, a little above the 1959 figure, and the year-end backlog of unfilled orders, at $1.221 million, was also above the previous total.

The report shows that Lockheed has earned a total of $392,815,000 on Electra sales (including orders on hand). Write-offs of development expenses since the start of the project, together with excess production costs and inventory write-downs, have exceeded this figure by $120,738,000. Allowing for tax recovery on this sum, the net loss on the Electra over six years is $57,954,000. Part of this may be recovered on sales of spares in the future, and there is also the promise of substantial production of the P3V anti-submarine version of the Electra for the U.S. Navy. A $53 million follow-on contract for the P3V was placed in 1960 and ensures production into 1962.

Zero-Zero Ejection

APPLICATION of rocket boost to the standard Martin-Baker ejection-seat was proved on Apr. 1 to have given this a zero height and zero speed capability for its installation in VTOL aircraft. After more than 100 dummy tests, the first live zero-zero ejection was made by Mr. W. T. H. Hay with complete success, with a peak trajectory of well over 300 ft. during parachute deployment and separation, from ground level.

One of the most important features of the Martin-Baker rocket system is that it is a direct continuation of the development in ejection-seats which has led to the widespread use of a lightweight unit with runway escape capability at speeds of not less than 90 knots. Using an 80 ft./sec. telescopic ejection gun, this seat guarantees a safe escape under those conditions, provided that the aircraft is in a level attitude or is not nose-down at the time. In the latter case, a nose-down attitude will tilt the seat trajectory forward and allow insufficient height for parachute deployment.

The attachment of the Martin-Baker rocket unit reduces the probability of that happening, and also overcomes the problems encountered with existing rocket seats elsewhere. These invariably have the rocket charges fitted to the ejection gun, and the resultant displacement of thrust drives the seat forwards and upwards at an angle of about 45°, which may give rise to difficulties in the nose-down ejection case close to the ground.

In the new Martin-Baker seat, the rocket thrust, which is separate from the ejection gun, is applied by an ingenious patent mechanism under the C.G. of the seat and parallel to the axis of the gun. At one stroke, this overcomes the critical problem of aligning the rocket thrust through the C.G., whatever the weight of the ejected mass, to avoid tumbling, and of thrusting the seat upwards and backwards for the optimum ejection trajectory regardless of aircraft attitude.

This was shown at Chalgrove during the live ejection, when Mr. Hay landed some distance behind the launching frame. The rocket appeared to fire fractionally after actuation of the telescopic gun with the face-blind, and the very high thrust over not more than one-half second sent the ejected mass high into its trajectory, with the drogue gun extracting the duplex extractor parachutes while the seat was still on its way up. The main parachute was then deployed at the peak of the

MAINTAINING THE TRADITION.—At the 10th annual reunion dinner of the Avro 504 Club, Alec G. Read, the best apprentice for 1960, received the trophy, cuff links and memento from Sir Roy Dobson. Guests for the occasion were Mr. R. E. Hardingham of the Air Registration Board, Gp. Capt. Douglas Bader and Mr. E. C. Bowyer of the S.B.A.C.

OFF WITH A BANG.—Mr. W. T. H. Hay made the first live ejection with the rocket-boosted Martin-Baker seat at Chalgrove on April 1. This action photograph shows how the rocket thrust exhausts vertically downwards beneath the centre of the ejected mass.

trajectory, plucking Mr. Hay from the seat, which then fell away.

Deployment of the main parachute was complete by about 250 ft. above the ground, at the start of the descent, illustrating the wide margin conferred by the rocket assistance. Although this could be considered as an early development of the rocket boost, its application to existing Martin-Baker seats is obviously simple, and it provides an additional safety factor for conventional jet aircraft in addition to an essential safeguard for VTOL and STOL types.

Bill Bedford, chief test pilot of Hawker Aircraft, and currently testing the P.1127, the first VTOL fighter, was an interested spectator of the ejection. It is probable that for high-speed aircraft, the rocket boost will remain operative at all times, and its use will not minimize the survival potential of the seat at the upper end of the speed scale. An additional practical feature of the Martin-Baker system for absolute safety is a three-position adjustment of the rocket nozzles, over very small angles, for light, medium or heavy pilots, to maintain the optimum trajectory.

Production Planned for Executive Jet

HAWKER SIDDELEY'S range of civil transports was extended last week when it was announced that de Havilland are to build an initial production batch of 30 D.H. 125 executive aircraft. Deliveries of this small jet transport will begin in 1963. Regarded as a turbojet replacement for the Dove and Heron it is to carry a crew of two and six or eight passengers over stages up to 1,500 miles, cruising between 450 and 500 m.p.h. De Havilland state that the D.H. 125 is a long-term project involving an investment of several million pounds. A large demand for this aircraft is anticipated from industrial and business houses; it is expected that the type may well remain current for 20 years.

The D.H. 125 is a typical small jet transport in the modern manner, with rear-mounted engines and a T-tail. In appearance it is very similar to the BAC-107 and Avro 771 projects. First news that de Havilland would build the D.H. 125 was given in our Feb. 3 issue.

The aircraft, to be fully pressurized and air conditioned, will be designed to operate from small airfields. It will have simple airframe systems. All-up weight will be about 18,000 lb.

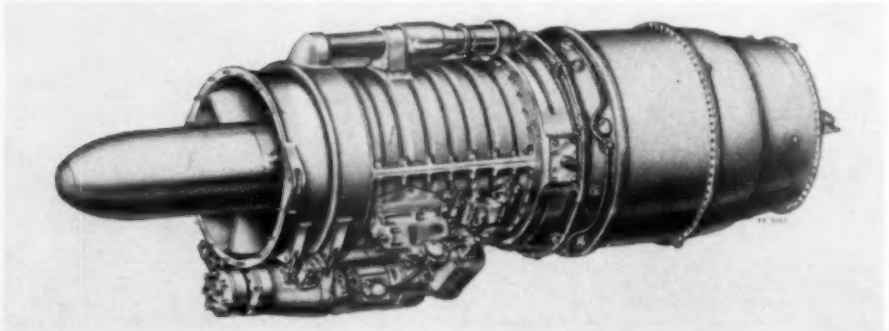
The D.H. 125 has a cylindrical cabin a foot or so wider than that of the Dove, giving a headroom about the same as in the Heron. The wing is set low on the fuselage to avoid any obstruction of the cabin by the main spar.

This new executive type is to be powered by two Bristol Siddeley Viper 20 turbojets. This civil turbojet is in effect a Viper 11 with an additional, or "zero," compressor stage. Mass flow has been increased from 44 lb./sec. to 52.8 lb./sec. and static thrust from 2,500 to 3,000 lb. Specific fuel consumption has been improved from 1.07 to 0.985 lb./lb./hr. The Viper 20 has been designed to meet all civil requirements, including anti-icing, and is conservatively rated; its turbine entry temperature is 25°C. less than for the Viper 11. Test-bed runs of the Viper 20 will begin later this year.

Because of its high speed, it is claimed that the D.H. 125 will have operating costs per mile which are little if any more than the costs for the Dove. This claim is interesting because the first cost will be very much higher. It is understood that a D.H. 125 may well cost up to four times as much as a Dove. Basic price of a new Dove is £36,000.

De Havilland state that the D.H. 125 will benefit greatly from the years of research which went into the Trident and that the D.H. 125 design "is well suited to occupy technical staffs responsible for the Comet and Trident jet airliners."

The decision to produce a jet executive follows several years of market research. De Havilland have more than 30 years' experience of producing aircraft for business travel and the D.H. 125 represents a major advance in this field. In changing from a Dove to a D.H. 125, it is claimed that a businessman's travelling time will be cut by more than half without additional expense.



JET EXECUTIVE.—With a luxurious seating layout the D.H.125 will carry six passengers; it will take eight passengers with seating to airline standards. It is powered by two Bristol Siddeley Viper 20 engines (right). Developed from the Viper 11, this civil turbojet gives 3,000 lb. thrust for take-off.

Aviation News in General

INDIA'S 748.—According to a correspondent in India, the fuselage of the first Avro 748, being made at Kanpur, has been completed. The I.A.F. factory there hopes to have three aircraft finished by the end of this year. The first six Indian 748s will have imported Dart powerplants; subsequent aircraft will have engines which have been assembled by Hindustan Aircraft at Bangalore.

MIRAGE CONTRACT.—The contract for the purchase of 30 Dassault Mirage III fighters for the R.A.A.F. was signed on Mar. 30 in Paris by Dr. E. R. Walker, Australian Ambassador to France, and M. B. C. Vallieres, general manager of G.A.M.D. The Government Aircraft Factory and the Commonwealth Aircraft Corporation will share in the manufacture of the Mirage in Australia, in which 2,000 people will be eventually employed.

TURBINE WHIRLWIND.—Flight trials have just begun with the first production Westland Whirlwind 10 helicopter for the R.A.F., illustrated here. It is powered by a 1,050-s.h.p. de Havilland Gnome free-turbine engine.

DECCA FOR PORTUGAL.—The Decca Type 424 airfield control radar is to be supplied to the Portuguese Air Force, the ninth to adopt this landing aid. It will be mounted on a specially designed trailer which incorporates the operator's control position and will be fitted with Ekco CR/DF and Pye VHF.

EXPORTS.—Aircraft designed by de Havilland Canada have been exported to 62 countries and earned $167 million in export revenue.

B-52 SHOT DOWN.—On Apr. 7 a Sidewinder heat-homing AAM was accidentally launched from an F-100 interceptor and shot down a Boeing B-52 bomber over New Mexico. Three of the bomber's crew of eight died in the crash. The fighter was making training attacks on the bomber; during the sixth pass the missile "was released," to quote the U.S.A.F. The F-100 was flown by an Air Guard (reserve unit) pilot.

OVERHAULS AT PRESTWICK?—According to reports from Scotland, as part of its policy of diversification Scottish Aviation, Ltd., hopes soon to gain contracts for the overhaul of transports in the Viscount/Vanguard class. At present about 20% of the company's work is aircraft production, 30% aircraft overhaul, and the balance is engine overhaul and light engineering.

GRUMMAN/KAMAN VTOL.—Kaman Aircraft is to join Grumman in submitting a proposal for the U.S. "Tri-Service VTOL" competition for a VTOL transport suitable for all three U.S. Services. If this proposal wins the competition, Grumman would be prime contractor and weapons system manager; Kaman would be responsible for designing dynamic components such as lifting propellers, shafts and gearboxes. Kaman has constructed a test aircraft using the features involved. Based on a Grumman Goose amphibian, it has pivoting rotors. Its first flight is expected soon.

BELVEDERE PROGRESS.—It was announced last week that the Westland Belvedere twin-rotor helicopter for the R.A.F. has now received its full CA release.

MIDDLE EAST AID.—Four Jet Provosts are said to be included in a gift of British military equipment to the Sudan for which Parliamentary approval is to be sought. Facilities for training Sudanese pilots in this country are also to be offered.

DRONE METEORS.—Deliveries of the Meteor U.Mk.21 target drone to Woomera began on Jan. 23, 1961. This designation applies to the Meteor F.Mk.8 converted by Flight Refuelling, Ltd., to Meteor U.Mk.16 standard for use in the U.K., and further modified by Fairey Australasia for use at Woomera.

MORE URGE.—Second stage of the Saturn C-1 booster, the S-IV, being developed by Douglas Aircraft Co., will now be powered by six Pratt & Whitney LR-115 rocket engines each of 15,000 lb. s.t. Formerly it had four 17,500-lb. units.

CANADIAN NEWS.—Canada's Army has ordered 21 Hiller UH-12E helicopters and received two Cessna L-19Ls. The R.C.A.F. will get three additional Hillers for training and two Vertol 107-II helicopters.

HELI-DUNKER.—This helicopter ditching trainer has been developed by the Kellett Aircraft Corp. It has a mock HUS-1 helicopter fuselage which is lowered into a pool to simulate different types of crash.

"THE FLYING YEARS."—Sir Alan Cobham's four programmes in this series are to be repeated on the B.B.C. Television network. A number of corrections have been made to the original. Transmission of the first was on Apr. 10 and subsequent parts will be screened from 18.20-18.50 hrs. on Monday evenings.

FOR SPORTING MOTORISTS.—The annual racing and sports car number of our associated journal *The Motor* will be published next Wednesday, Apr. 19, price 1s.

FRENCH SPACE TESTS.—In a "memorandum of understanding" signed between NASA and the French Committee on Space Research, it is revealed that the latter expects to make detailed proposals for experiments "in the VLF, auroral and airglow, and biological fields" to be flown in appropriate sounding rockets by NASA. It is anticipated that the same experiments will later be incorporated in NASA-launched international satellites.

COSPAR MEETING.—No fewer than 27 nations are represented at the second International Space Science Symposium which opened in Florence on Monday.

MORE BLUE STREAKING.—British technical experts are expected in Bonn shortly for further talks with the Germans concerning the project to adapt Blue Streak as a European heavy satellite launcher.

INDIAN TRANSPORTS.—According to the Indian Prime Minister, only two of the Antonov An-12 transports purchased from Russia had arrived by the beginning of April. Six more are on order. Russian pilots are flying with the Indian crews for the first few weeks of operation in support of the Border Road Development Board. Other Indian purchases are reported to include a few Il-14s.

FAULTY DISCOVERER.—A Discoverer satellite, launched from Vandenberg A.F.B. on Mar. 30, failed to go into orbit. It carried samples of living tissue in a 300-lb. re-entry capsule as part of a radiation experiment. Capsule was to be ejected after one to four days depending on weather conditions off Hawaii (the intended recovery area) and the operation of the satellite.

DISCOVERER SUCCESS.—Success attended the launching from Vandenberg A.F.B. on Apr. 8 of another Discoverer satellite. Recovery of a 300-lb. capsule was expected after four days.

Commercial Aviation Affairs

TROUBLE AT FIUMICINO. — Because of faults which have developed since the airport was opened early this year, the main runway (16/34, 12,800 ft.) at Rome's Fiumicino, is to be closed for repairs for about a fortnight in the early part of next month. The second runway (07/25, 6,808 ft.) will be used, but this is likely to be too short for long-haul turbojet operations and there is the possibility that Ciampino's slightly longer runway (16/34, 7,218 ft.) may have to be used.

THE JP4 CONTROVERSY.—T.W.A., one of the four major airlines which have been named as users of JP4, stated last week that during 1960 its system-wide use of this wide-cut fuel amounted to only 2% of the total fuel uplifted and a similar small percentage, based on availability, will apply during this year. At no time has T.W.A. used JP4 on flights to or from London.

UNDERCARRIAGE TROUBLE.—On the night of Apr. 2 a T.C.A. Vanguard was successfully belly-landed at Montreal International Airport when one of the undercarriage legs jammed in its doors. The carrier's fleet of seven Vanguards was in the air again on Apr. 4 after checks and inspections. As a matter of course, B.E.A. also inspected the undercarriage-door mechanisms of its Vanguards.

VIASA IN ACTION.—On Apr. 6, VIASA, the new international carrier of Venezuela (see our issue of Mar. 23, p. 314), started services, with chartered K.L.M. DC-8s and crews, on the Caracas-Europe route.

NO FIDO.—According to a reply in the House of Lords on Mar. 28, the Ministry of Aviation has decided that no useful purpose would be served by installing FIDO at Heathrow. Lord Mills said that difficulties during trials of improved equipment make it seem unlikely that FIDO could be in operation before 1965 and it would have had a limited (and very expensive) useful life before automatic landing system came into operational use in about 1967.

HERALD ON SHOW. — A Dart Herald has recently been undertaking a new series of European sales tours; these have included a demonstration in Wales to directors and executives of Cambrian Airways. The present series will end with a visit to Sweden, where heads of airlines and of the armed Services will see the aircraft.

INTERNATIONAL ARAB AIRLINE. —At a conference in Baghdad last week a £17 million scheme for an international Arab airline was provisionally approved. This would operate all long-haul external services from the area. The United Arab Republic (Egypt and Syria) and Iraq agreed to subscribe 20% each of the capital, with Kuwait and Saudi Arabia contributing 15% each.

B.U.A. REORGANIZATION. — The Overseas Contracts Division of British United Airways is being combined with the Helicopter Division under the name Airwork International, Ltd. This wholly owned B.U.A. subsidiary will take over the subsidiary companies which previously comprised the Helicopter Division.

T.W.A. PROFIT. — Despite heavy losses on domestic operations because of re-equipment delays, bad weather and other factors, Trans World has returned a consolidated net profit of £2,311,785 for 1960.

CHILEAN CRASH.—An LAN DC-3 disappeared on the night of Apr. 3-4 while on a flight from Castro (Chiloe Island) to Santiago. On board were 23 passengers and a crew of three. Heavy icing had been reported in the last radio message.

DOCKSIDE HELICOPTER.—One of British United Airways' Westland Whirlwinds, which is being shipped to Trinidad for oil-field work, was flown on Apr. 4 from Redhill directly to the West India Dock, London, where, with main rotor blades and tail rotor removed, it was loaded by sling aboard M.V. "Speaker."

EUROPEAN TRAFFIC.—The latest figures for the 12 member airlines of the Air Research Bureau show an increase of 17% in passenger-miles for February, 1961, by comparison with February, 1960, and of 18% in seat-miles offered. The passenger load factor averaged 46%. The figures for the 12 months ended on Jan. 31 show an increase of 19% in passenger-miles over the previous year's figures.

ANSETT-A.N.A. IN THE U.K.—B.O.A.C. is now the U.K. general sales agent for Ansett-A.N.A. of Australia.

VERTOL 107 EVALUATION.—Lake Central, one of the U.S. local-service airlines, has been the first non-helicopter operator to evaluate the Boeing Vertol 107 prototype. It was operated by Lake Central, with a Boeing captain, on a nine-day series of flights, with stops at five cities in the airline's network between Pittsburgh and Chicago.

NOT SO YOUNG.—In a recent news paragraph (issue of Mar. 23, p. 311) the impression was given that H. Clarkson (Air and Shipping Services), Ltd., might be a newcomer. In fact, the company was a founder member of the Air Brokers' Association (1946) and is a "comparative newcomer" only in the field of aircraft sales.

DC-8 DELIVERIES.—Last month Panair do Brasil took delivery of its two Series 30 DC-8s. They were both flown from Miami to Rio de Janeiro with spare engines in "fifth pods."

News About People

TEST PILOT.—Mr. Denis Tayler, whose appointment as chief test pilot of Short Bros. and Harland, Ltd., is reported on page 392.

ROYAL F.S.F. GOVERNOR. — H.R.H. Prince Bernhard of the Netherlands has been elected to the board of governors of Flight Safety Foundation. Prince Bernhard is a qualified pilot with more than 5,000 hours and over a hundred types in his logbooks. He won his wings in 1941 while serving with the Allied Forces in England.

RECOGNITION.—For their "major contribution to world air safety through joint development of the line and bar approach lighting system and the visual glide path indicator now installed and in use at many major airports," Mr. E. S. Calvert and Mr. J. W. Sparke have been awarded the 1961 Laura Taber Barbour Air Safety Award. Both are now engaged on advanced research at the R.A.E., Farnborough, to improve aircraft safety.

RADIO MANAGER.—As the new European manager of Collins Radio International, Mr. H. C. Briggs will be based in London and have administrative responsibility for Collins Radio Co. of England, Ltd., and other company offices and subsidiaries in Europe.

I.C.I. METALS CHANGES.—Newly appointed chairman of the metals division of Imperial Chemical Industries, Ltd., is Mr. St. John de H. Elstub. He succeeds Mr. M. J. S. Clapham who has joined the company's main board as an overseas director. Dr. W. H. G. Lake fills the position vacated by Mr. Elstub, that of joint managing director (technical), of the metals division. In 1954 Mr. Elstub was awarded the C.B.E.

S.A.A.F. MISSION.—Members of a South African Air Force mission visited Brough recently to see Buccaneers in production and fly in the aircraft. Inspecting a wing panel are (left to right), Mr. T. Bancroft, Blackburn production director; Kommandant Blaauw; Colonel Verster; Mr. Barry Laight, Blackburn director and chief designer; and Major Melville.

Faster—over the top

Scandinavian Airlines initiative links Europe to the Far East by the fastest service of all—flying DC-8C aircraft 'over the top' by the short trans-polar route that SAS itself pioneered in 1957. 23,000 passengers travelled this North West Passage route in the first four months of the new jet service, taking advantage of new record times between Europe and Alaska of only 8½ hours. By cutting down time on the ground AIR BP's high-speed fuelling contributes to the success of this pioneering service.

Fast flying SAS... fast fuelling AIR BP

Plessey

TELECOMMUNICATIONS

'clear the air'

Plessey is everywhere, you'll find . . . in the Royal Navy for example, where strike aircraft of the Fleet keep a watching brief on the skyways and maintain contact with the help of Plessey UHF.

Behind this achievement are the extensive prototype and quality manufacturing resources of the Telecommunications Division, inspired by the work of a unique research and development organisation. The Company recognises the need to segregate advanced thinking from the hustle and distraction of the factory. Accordingly, in addition to the Group Research Laboratories at Roke Manor and other specialised research centres already existing in the U.K., extremely well equipped laboratories have recently been established at West Leigh for advanced Telecommunications studies. In these establishments, the next generation of telecommunications equipment is already taking shape.
In close support at all times are the complete resources of the Plessey Group of Companies which include unrivalled tool making and machining facilities, a full range of environmental testing and production laboratories, and the service of the materials laboratories at Caswell.

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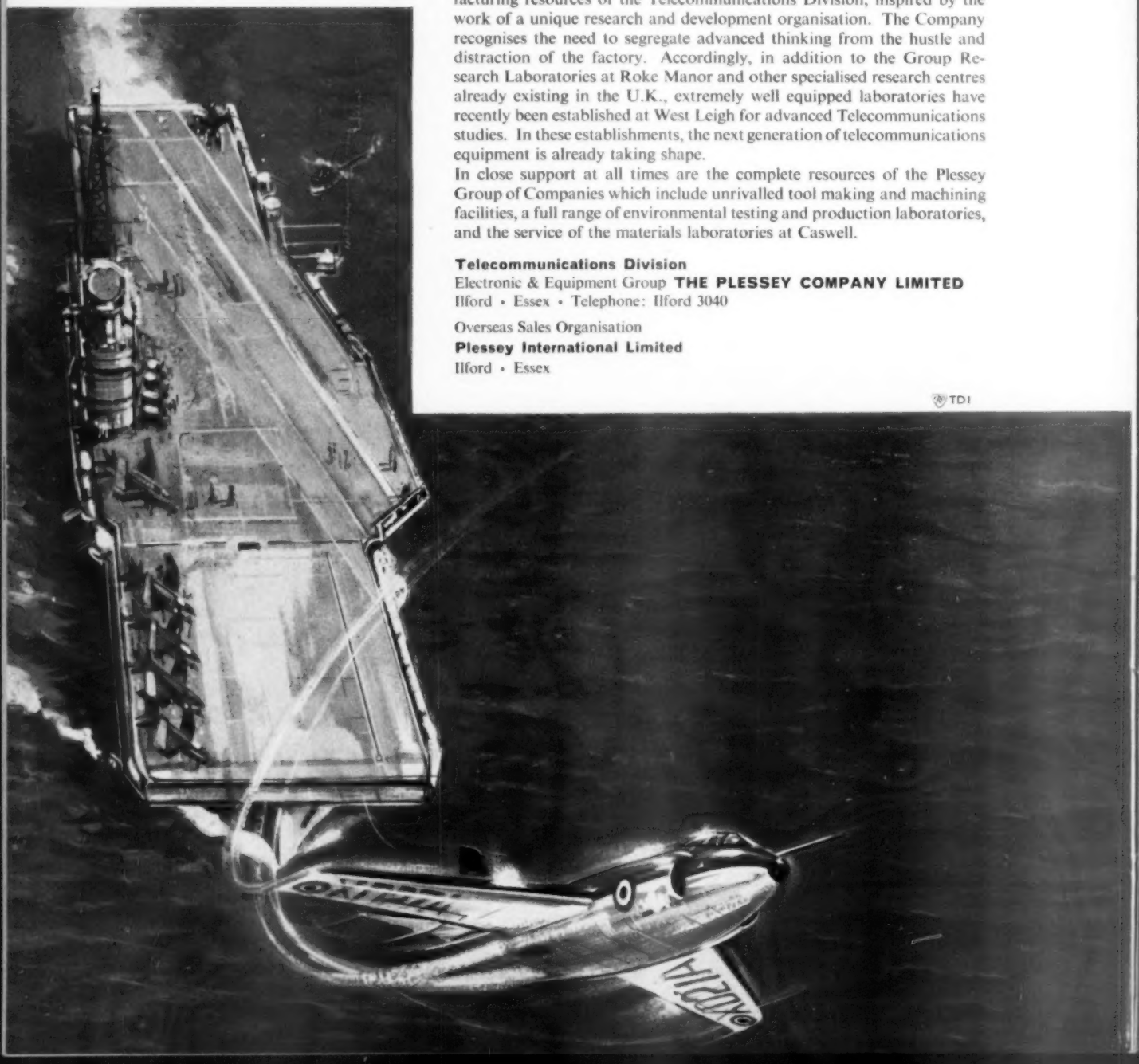


Matters of Moment . . . .

Ground Stations for Relay and Rebound

A CO-OPERATIVE programme for the transatlantic testing of experimental communication satellites provided and launched by NASA has now been officially announced jointly by the United States, Great Britain and France. These moves were foreshadowed in our article, "Go-ahead for Satellite Relays," published on Feb. 3, 1961.

The British G.P.O. and the French Centre for Telecommunications Studies have agreed to provide ground stations in Europe for the transmission of multi-channel telephone, telegraph and television signals using satellites to be launched by NASA during 1962 and 1963 in Projects Relay and Rebound.

The ground stations will be equipped with advanced radio facilities having extremely accurate tracking and antenna pointing qualities and capable of conducting tests with active and passive satellites at high frequencies and low power. Surveys are at present being made to determine their locations and, as previously reported, the British ground facility is expected to be established in Cornwall at a cost estimated at some £500,000.

Project Relay, NASA's low-altitude active repeater satellite, to be launched for the first time in 1962, will weigh less than 100 lb. In addition to the transceiver electronics, it will contain instruments for the purpose of detecting any radiation damage and other environmental effects likely to influence critical components as well as the communication experiments themselves.

Project Rebound is a continuation of NASA's first passive communication satellite programme, Echo. It is proposed to place several "rigidized" inflated spheres of 135 ft. diameter into orbit using a single launching vehicle. The first attempt to orbit three spheres is scheduled for 1963.

As we have pointed out in previous articles, Relay and Rebound are research and development projects to demonstrate the feasibility of basic concepts and technological approaches, and to evaluate various systems to be employed in communication satellites. The co-operating nations will welcome participation by other countries should they desire to provide additional ground facilities for the experiments.

Japan Shoots High

A JAPANESE three-stage rocket was successfully launched from the Akita Rocket Range of Tokyo University to a record height of 217 miles on Apr. 1. It was the first three-stage sounding rocket to be fired in Japan. Kappa-9, as the rocket is called, employs solid propellents and is a combination of two earlier Japanese rockets, Kappa-6 and Kappa-7. The research and development programme was described and fully illustrated in our issue of Oct. 7, 1960.

The new three-stage rocket has an overall length of 39.4 ft. and a launching weight of 1.53 tons. When ramp-launched at an angle of 80° its designed maximum altitude is 223 miles; vertically launched, it should reach 260 miles. It is expected to play an important part in Tokyo University's expanding programme of research into the upper atmosphere, including the study of high energy particles, cosmic rays, etc.

At present Japanese scientists are negotiating with NASA for the purpose of acquiring payload space in one of the international satellites to be launched by American Scout rockets from Wallops Island, Virginia. If they are successful, the experience gained from Tokyo University's programme of upper atmosphere research will be of vital consequence in designing research instrumentation for the satellite.

Meanwhile, in terms of rocket hardware, there are plans for providing Kappa-9 with a fourth stage powered by a small spherical rocket motor. Last year both steel-cased and glass-fibre reinforced plastic motors were static-fired using a three-dimensional star-type solid propellent of high specific impulse, and it is anticipated that mass ratios as high as 15 can be realized. It is proposed to spin-stabilize the final stage by mounting it in a gimbal frame at the head of the third stage.

A Tumbling Satellite

A NEW scientific satellite, the S-15, is expected to be launched by a Juno II four-stage rocket from Cape Canaveral this month. Its purpose will be to detect high-energy gamma rays from cosmic sources (as from our own galaxy and neighbouring galaxies such as the Magellanic clouds) and map their distribution in the sky.

According to NASA, this will be the first attempt at "gamma ray astronomy" from a satellite. Scientists are now limited in their study of extra-terrestrial gamma radiation because their measurements are affected by existing radiation in the Earth's atmosphere.

Composite photograph copyright "The Aeroplane and Astronautics"

AWARD FOR VTOL.—Mr. Tom Brooke-Smith, until recently chief test pilot of Short Bros. and Harland, Ltd., receives from Lord Brabazon the Segrave Trophy for 1960, awarded in recognition of his outstanding demonstration of the possibilities of VTOL operation with the Short SC.1.

The satellite itself, which NASA states resembles "an old-time street lamp" and certainly looks unlike any other satellite launched to date, takes the form of a 12-in. wide, 23.5-in. long octagonal box mounted on a 6-in. diameter, 20.5-in. long instrument column. It weighs 82 lb. The box provides a housing for the gamma ray telescope and on four of the external surfaces are mounted the satellite's solar cells. The 44 in. long fourth stage rocket will remain attached to the satellite after it has arrived in orbit.

This extension will act as a section of a transmitting antenna and provide the additional mass needed to ensure the S-15's tumbling motion which is necessary to enable the gamma ray telescope, which looks out through the end of the octagonal box, to scan a portion of surrounding space every six seconds. The satellite will actually tumble end over end about 10 times a minute controlled by a unique mercury damping mechanism.

Sun and Earth sensors, looking out through small apertures in the micrometeorite shield, will permit ground stations to know at all times the precise orientation of the vehicle with respect to the Earth, Sun and stars, thus pin-pointing the direction from which the gamma rays are coming. An insulated temperature sensor, also directed out through the thin shield, is designed to study the thermal radiation balance in orbit.

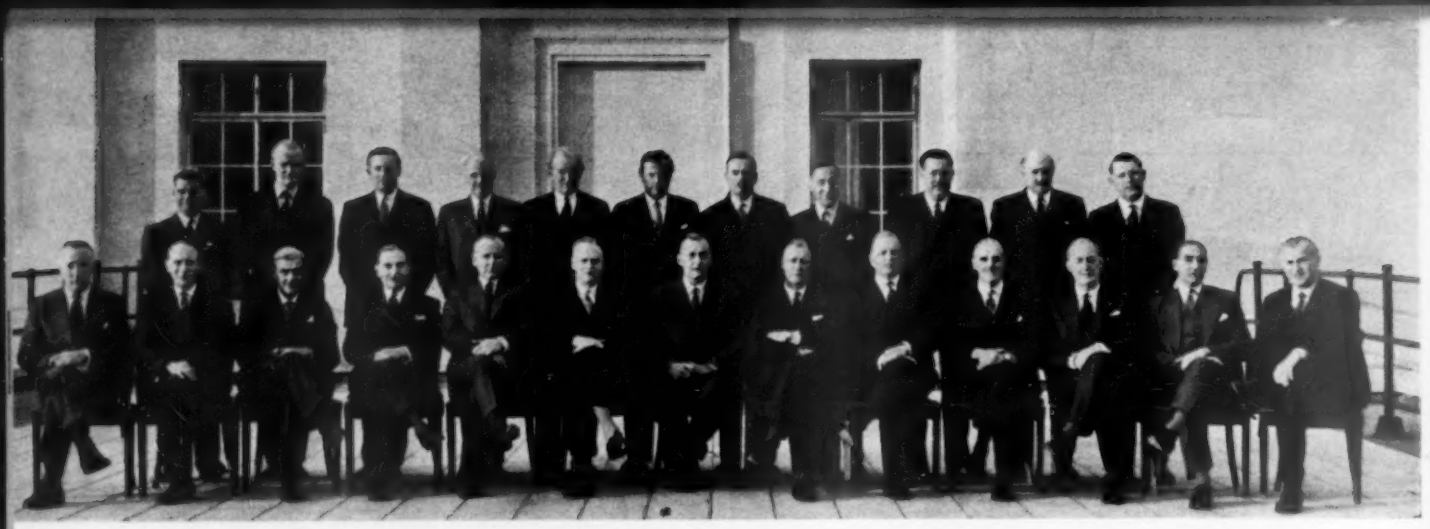
The intention is to launch the satellite into an elliptical, low inclination, orbit in order that: (a) the initial spin axis of the payload will be in such a direction that the telescope will scan the Sun during the early part of its lifetime; (b) it will have a lifetime exceeding six months; and (c) an appreciable fraction of the time will be spent below the inner Van Allen radiation belt.

Thus, the satellite is designed to enter an orbit which is inclined at about 28° to the Equator; the apogee should be about 700 miles and the perigee about 300 miles. It is intended, in this orbit, to circle the Earth once every 98 minutes.

Two Easter Gliding Rallies

AT its previous Easter rallies the Midland Gliding Club has always had at least two contest days and sometimes four. This time it had none. However, a strong west wind on Friday and Saturday enabled soaring to be done over the Long Mynd, whenever the cloud had lifted far enough above it, and on the first of these days 46 hours flying from 67 bungy launches were flown by most of the 30 pilots and 19 sailplanes entered.

At last, on Easter Monday, four competitors managed to get away; but only Stuart Morison of the Army Club, by flying 25 miles to Bewdley in the club Skylark 2, and J. Chandler, of the R.A.F. Moonrakers, with 20 miles to Tenbury,



R.A.F. EXECUTIVE.—At the recent Chief of Air Staff's Conference in the Air Ministry were:—
Back row (left to right): Air Marshals, Sir Wallace Kyle, A.O.C.-in-C., Technical Training Command; and Sir Anthony Selway, C.-in-C. F.E.A.F. Air Vice-Marshals, A. Foord-Kelcey; and D. J. P. Lee, A.O.C., Air Forces Middle East (Aden). Air Marshals, Sir Hector McGregor, A.O.C.-in-C., Fighter Command; J. Grandy, C.-in-C., R.A.F. Germany; Sir Walter Cheshire, A.O.C., Malta; Sir Edward Chilton, A.O.C.-in-C., Coastal Command; Sir Leslie Dalton-Morris, A.O.C.-in-C., Maintenance Command; Sir Herbert Spreckley, Controller of Engineering and Equipment; and Sir Kenneth Cross, A.O.C.-in-C., Bomber Command.
Front row (left to right): Air Marshals, Sir William MacDonald, A.O.C.-in-C., N.E.A.F.; and Sir Denis Barnett, A.O.C.-in-C., Transport Command. Air Chief Marshal Sir Theodore McEvoy, Air Secretary. Air Marshals, Sir Walter Merton, Air Member for Supply and Organisation; R. B. Lees, Deputy Chief of Air Staff; and Sir Arthur McDonald, Air Member for Personnel. The C.A.S., Air Chief Marshal Sir Thomas Pike. The V.C.A.S., Air Chief Marshal Sir Edmund C. Hudleston. Sir Maurice Dean, Permanent Under-Secretary. Air Chief Marshals, The Earl of Bandon, Commander, AIRCENT; and Sir Hubert Patch. Air Marshals, Sir John Whitley, Inspector General of R.A.F.; and Sir Hugh Constantine, A.O.C.-in-C., Flying Training Command

Matters of Moment . . . .

exceeded the 15-mile minimum needed to score, so even that was not a contest day. Other visitors came from the Derbyshire and Lancashire, Southdown, Yorkshire, Kent, London, Oxford, Portsmouth Naval and R.A.F. Moonrakers clubs.

Swanton Morley had even worse luck with the weather, for no contest flying was possible at all. This was the first Easter Rally to be laid on by the combined Norfolk gliding clubs, consisting of the Gliding Section of the Norfolk and Norwich Aero Club at Swanton Morley, the Norfolk Gliding Club at Tibenham, and the R.A.F. Fenland Gliding Club at Marham, while No. 611 Gliding School of the Air Training Corps at Swanton Morley co-operated without competing.

The organization was magnificent, and the Commanding Officer at Swanton Morley, Gp. Capt. Harland, provided a whole hangar where competitors' sailplanes could be kept rigged. He has allowed Peter Scott to keep his Olympia 419 there in case Buchan's Cold Spell should turn up at last with its unstable north-easterlies blowing from Norfolk to Cornwall. In fact, it was the prospect of making a 500-km. flight for the Diamond badge which attracted most of the 33 competitors to Norfolk with their 19 sailplanes. The rally will be held again next Easter, when better weather is confidently promised. —A.E.S.

An Air Minstry Appointment

AIR COMMODORE D. C. STAPLETON, C.B., C.B.E., D.F.C., A.F.C., has become Director of Joint Plans at the Air Ministry. Deputy Director of Organization since December, 1959, Air Cdre. Stapleton, was previously Group Captain (Plans and Policy) at Headquarters, Bomber Command. From 1955 to 1957 he commanded R.A.F. Oldenburg, Germany.

R.A.F. Gliding at Bicester

FOUR races were flown by past and present members of the R.A.F. gathered at Bicester for a 10 days' competition to practise for the forthcoming National Gliding Championships. On the opening day, Saturday, Mar. 25, a 40-mile race southwards to Lasham across a west wind was won by Wally Kahn at 21 m.p.h., with David Ince and Sgt. John Williamson close behind. Two days later, Gp. Capt. "Paddy" Kearon averaged 25 m.p.h. on a 60-mile dog-leg course to Lasham via Andover in a N.N.W. wind, with Sgt. Andy Gough and Wally Kahn second and third.

Cross-country speeds then made a big jump on Mar. 28 when David Ince flew 60 miles eastward to Debden with a following wind, in just an hour; Williamson and Kahn tied with 1 hr. 8 min., and the rest of the 16 competitors, all but one, got there. After that the Easter weather clamped down, and the only remaining contest day was Good Friday, when Sqn. Ldr. E. T. Ware went farthest, but not very far, along the route to the goal at Swanton Morley in Norfolk.

At the following day's briefing the met. man produced a fantastic chart showing how the dirty westerly weather would be swept away by an unstable north-easter, and a distance task was announced. Competitors were already ruling lines on their maps down to Cornwall when they suddenly remembered the date: April the First.

Leading final totals were: W. A. H. Kahn, 2,382 points (no longer in the R.A.F., therefore *hors concours*); Sgt. A. Gough, 2,090½; Gp. Capt. N. W. Kearon, 2,003; Sgt. J. Williamson, 1,752; Flt. Lt. D. Spottiswood, 1,367; Sqn. Ldr. E. T. Ware, 1,315; David Ince (*hors concours*), 1,284; Flt. Lt. A. Loveland, 636; Flt. Lt. L. Kurylowicz, 568½; Sqn. Ldr. J. L. Bayley, 508.

All possible help was given by the station commander, Wg. Cdr. A. S. Mann, D.F.C., and his staff.—A.E.S.

Anglo-U.S. Navaid Collaboration

AN agreement for collaboration in the field of airborne radio and radar equipment has been signed by Marconi's Wireless Telegraph Co., Ltd., and Wilcox Electric Co., Inc., of Kansas City, Missouri. Covering the full interchange of design, engineering and production information, it also includes the manufacture and sale by either company of equipment designed by the other.

The Wilcox company was founded over 30 years ago and its interests have been devoted exclusively to the development and production of radio communications and navigation equipment for both ground and airborne installations. It is one of the two American companies who have received development contracts for airborne A.T.C. transponders from the Federal Aviation Agency.

New Chief Test Pilot for Shorts

MR. DENIS TAYLER, formerly a civilian test pilot with the Royal Aircraft Establishment, has been appointed chief test pilot of Short Bros. and Harland, Ltd. He succeeds Mr. Tom Brooke-Smith, who retired from test flying last September after demonstrating the Short SC.1 VTOL aircraft at the Farnborough Air Display.

Mr. Tayler, who was born at Lymington, Hants, in 1920, joined the Royal Air Force in October, 1939 and learned to fly at Marshalls Flying School, Cambridge, in 1940. In May, 1941, he joined 50 Squadron, Bomber Command, flying Hampdens, and in September, 1943 joined 139 Squadron of the "Pathfinder" Force. With this squadron he flew Mosquitoes until the end of the War, by which time he had completed in all some 100 operational sorties.

In July, 1945, he was posted to the R.A.E., Farnborough, to fly German aircraft back to England, and by December, 1945 he had flown more German aircraft than British. With the completion of these ferry flights Mr. Tayler joined the Experimental Flying Department of the Royal Aircraft Establishment, Farnborough. He has been stationed there or at Bedford ever since, having remained with the R.A.E. as a civilian test pilot when he left the R.A.F. in 1946. He has flown 150 aircraft types.

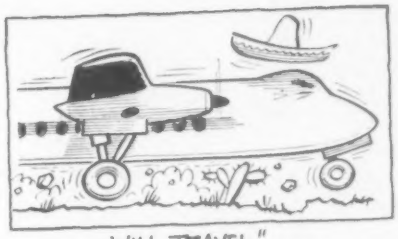
In recent months he has done a considerable amount of test flying for Shorts with the SB.5 and SC.1. His flight development work on the SC.1 has included a number of transitions between jet-borne and wing-borne flight, and he piloted the SB.5 adiustable wing research aircraft when for the first time it flew with 69° sweepback.

"WILL YOU TELL ME SOMETHING ABOUT YOURSELF, SIR?"

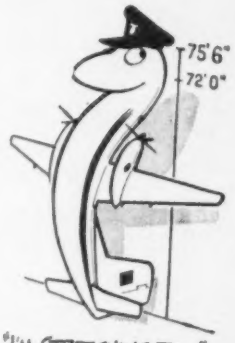
HERALD FOR THE WRECORD

by Gren...

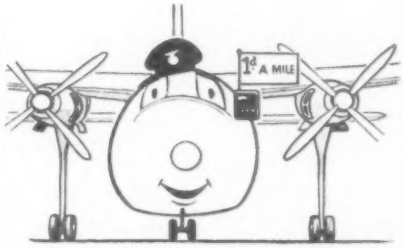
"HAVE PERFORMANCE.....



.....WILL TRAVEL"

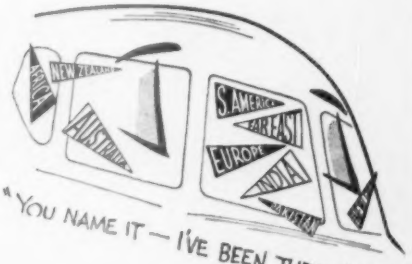


"I'M STRETCHING, TOO"

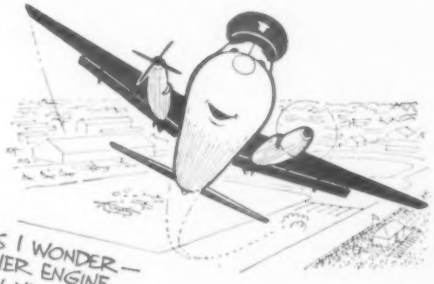


WELL, AS YOU SEE HERE, MY ECONOMICS ARE SHOWING— ABSOLUTELY FABULOUS!"

"ONLY THE BEST IS GOOD ENOUGH"

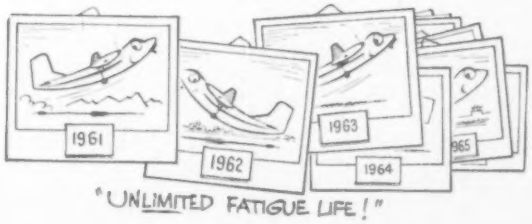


"YOU NAME IT — I'VE BEEN THERE."

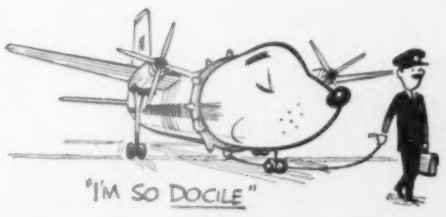


"SOMETIMES I WONDER— IS MY OTHER ENGINE ABSOLUTELY NECESSARY?"

"FREIGHT? MORE THAN SIX TONS OF IT!"



"UNLIMITED FATIGUE LIFE!"



"I'M SO DOCILE"

TO DATE 417 SUCCESSFUL ESCAPES

have been made using

MARTIN-BAKER EJECTION SEATS

The result of 16 years experience and more than 850 test ejections.

MARTIN-BAKER

COMMERCIAL AIRCRAFT OF THE WORLD

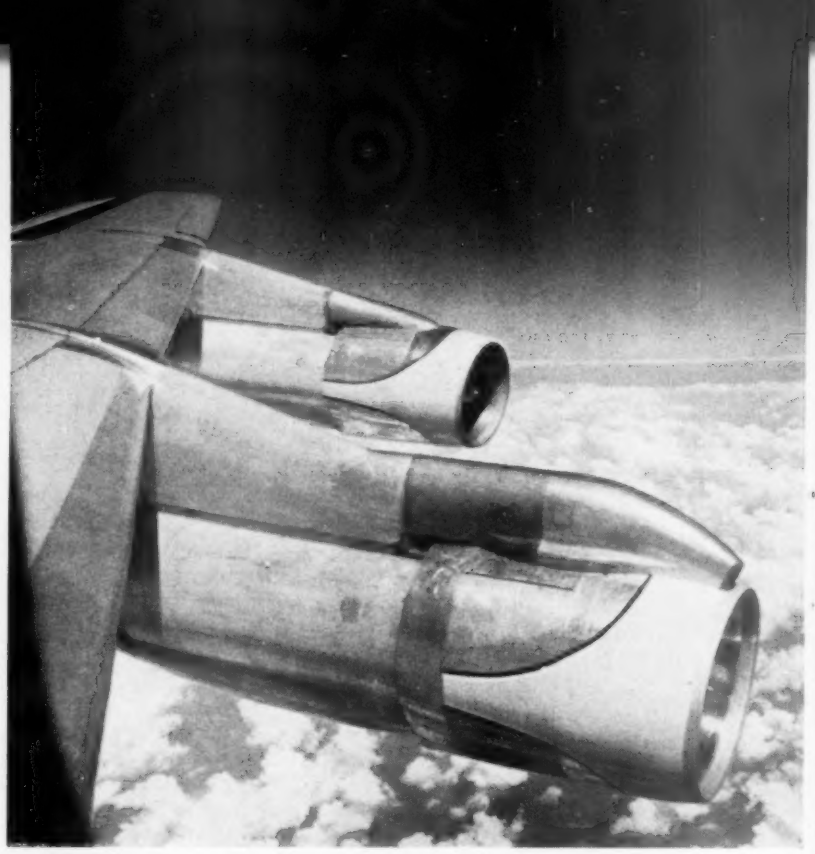
FOR this fifth annual supplement of THE AEROPLANE AND ASTRONAUTICS devoted to the World's commercial transport aircraft, a method of presentation has been adopted similar to that used last year. Apart from an introductory survey on the next three pages, the contents fall into five sections, comprising a complete listing of all airline purchases of turbine transports to date; a type-by-type review of current and projected transport aircraft; tabulated dimensional, weight and performance data reduced to a common basis for quick comparison; a unique ready-reference chart indicating the basic engineering details of 21 important turbojet and turboprop transports; and a table of civil gas turbine data.

The last-mentioned is a new feature this year, intended to increase the value of this particular issue as a lasting reference work. Also, for the first time this year, the scope of the aircraft review has been widened to take in all aircraft having a gross weight of 8,000 lb. or more; this permits the inclusion of some of the smaller piston-engined types which serve as airliners as well as for business and executive use. Notes on supersonic projects and commercial helicopters will be found separately grouped on pp. 414-415.

The series of notes on pp. 399-415, covering a total of 100 aircraft, contains references to all significant developments of the past 12 months and mentions first flight and other important dates for each type.

Commercial Aircraft . . . .

The Year in Review



The advent of turbofan engines—symbolized in this picture of JT3D-1s in a Boeing 720B—has been one of the most significant events in commercial aviation in the past 12 months.

IN the past 12 months new orders for nearly 300 turbine transports placed by scheduled airlines have swelled the total World fleet—delivered or on order—to approximately 2,000, including some 250 of Russian origin. A large proportion of the new sales have been re-orders by airlines which were already committed to jet fleets, but one of the most significant facts of the year is that half of all the turbine transports sold are powered by turbofan or by-pass engines. The proportions, for the 12 months up to Mar. 31, 1961, are:—

Turbofan	141
Turbojet	83
Turboprop	58

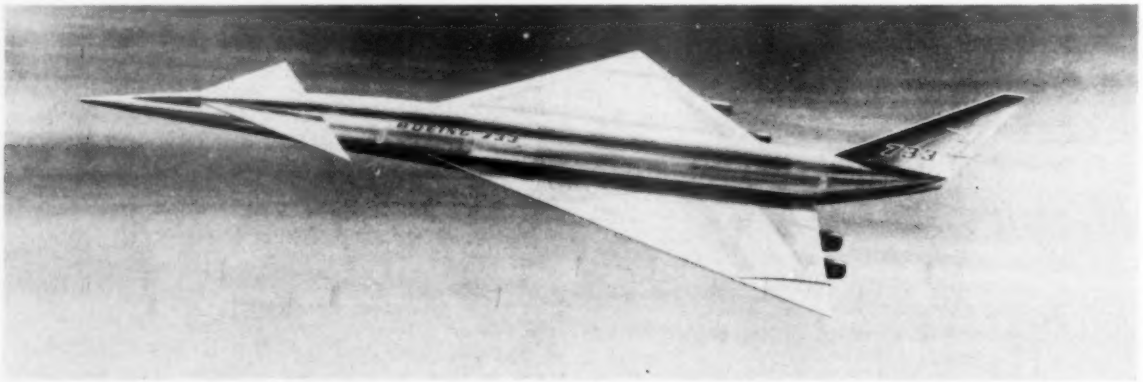
Operational airline experience with the double-flow engine (this term is used here to cover both the British by-pass types and the U.S. and Russian turbofans) began just a year ago when R.R. Conway-engined Boeing 707s went into regular service; in the course of 12 months the Conway DC-8 and Pratt & Whitney JT3D versions of the Boeing 707-120 and 720 have also entered service, while the Douglas DC-8 with JT3Ds, the Convair 990 with General Electric aft-fan engines and at least one Russian turbofan type, the Tu-124, are now in the flight test stage. Five other completely new types are under construction, all with this type of powerplant.

The double-flow engines, and especially those of more recent origin, offer the dual advantages of a greatly increased power/weight ratio and significantly reduced specific fuel consumption. Their application to the existing subsonic turbojets—as, for instance, in the Boeing 707-320B and Douglas DC-8—makes possible higher economic cruising speeds, allowing operators of these types to "control the speed race" in competitive situations; greater payloads over given ranges; and greater ultimate ranges.

All this represents an important bonus which many operators did not include in their original assessments of the likely profitability of their jet fleets and, although one airline vice-president recently said he was "a little aghast at the number of dollars the manufacturer is talking" for converting existing aircraft to have turbofan engines, such conversions will become increasingly common as the jet fleets become depreciated.

The newer double-flow engines, such as the R.R. Spey, Bristol Siddeley BS75 and P. & W. JT8D-1 offer even better economics than the "first generation" engines which, in the case of Pratt & Whitney and General Electric engines, are plain conversions of the JT3C and CJ805. The economy of the newer engines, in fact, is making it possible to extend jet travel down to the lower end of the range spectrum; many small airlines, which two years ago would have regarded jet equipment as prohibitively expensive and unnecessarily sophisticated for short-sector (under 500-mile) networks, now contemplate the acquisition of a small turbofan transport with equanimity if not eagerness.

While work has continued during the year on new versions of the large subsonic transports, the only completely new passenger types to have passed from project to construction status—the Boeing 727 and BAC-111—have been aimed at the short-haul market. The decisions by the boards of the Boeing Airplane Co. and the British Aircraft Corporation, respectively, to go ahead with these two aircraft—both rear-engined, both



The commercial supersonic transport has come closer with the financing of design study and development contracts by the British and U.S. Governments. Typical of the designs being studied is this canard delta with four podded engines.

with turbofan engines—will have a lasting effect on the commercial transport market, and must be counted as the most important events of the year, not only for the two companies, but for the British and American industries as a whole.

The Boeing 727 enters a highly competitive portion of the market, as a large-capacity short-haul mainliner for ranges of 500-1,500 miles. Already available in this general category are the Sud Caravelle and the D.H. Trident; projected developments of the latter two are being offered in competition with the 727 and these aircraft between them must obtain the lion's share of this market, which some estimates put as high as 1,000 aircraft over the next 10 years.

The BAC-111 breaks new ground as a jet feederliner, of smaller capacity than the 727/Trident/Caravelle series and of rather lower performance. As a deliberate attempt to provide a jet aeroplane able to take over from the several hundred Viscounts and Convairliners in service throughout the World, the BAC-111 appears to be the first contender for a new class of airline business, and its rapid development, now that the decision to go ahead has been reached, should put the British aircraft industry in a good position to capture this market.

Relative Successes

It is worth considering, at this point, the relative success which has attended the various manufacturers in the sale of turbine transports. Taking the record of the past twelve months alone, Boeing netted more than half the total new sales, both in quantity and value. This notable success was helped by the sale of 92 Boeing 727s, but, even excluding the latter, the new orders for 57 Boeing 707/720 variants far exceeded the next best sales success, which was 34 Caravelles sold by Sud Aviation. Vickers sold 13 more VC-10s; Douglas, 12 more DC-8s; and de Havilland, 10 more Comets; the sale of six more Convair 880/880-Ms was offset by the loss of the Capital order for seven.

In the turboprop field the F-27 was the best seller at the rate of one every three yeeks, and limited sales were recorded for the Avro 748, A.W. Argosy, H.P. Herald, Vickers Vanguard and Vickers Viscount. Russia's Il-18 consolidated its position as the only exportable Soviet turbine airliner.

Considering total sales of turbojet transports to date, the Boeing 707/720 family (272 sold) now has a clear and probably inviolable ascendancy over the Douglas DC-8 (159). Third most successful of the pure jets is the French Caravelle (116), followed by the Convair 880/990 family (97), with the Boeing 727 only just behind (92) and likely to overtake the Convair in the near future. Of the British jets, the Comet 4 (63) has proved the best seller to date, followed by the VC10 series (48) and the Trident (24).

Among the larger turboprops, the Viscount's record (429) is unassailable. Sales of the Electra total 168 and of the F-27 (combined Fairchild and Fokker production), 173. Excluding military variants, Bristol sold 59 Britannias and production of the Vanguard seems unlikely to go beyond the 43 now on order. Canadair have sold only 17 Forty-Fours (excluding military variants). Commercial sales of the Argosy (7 excluding military), Avro 748 (20 excluding military) and Handley Page Herald (12) can be expected to increase. The total sales of turbine transports, by country of manufacture to airlines grouped on a regional basis, are summarized in the table below.

WHERE THE AIRLINES BUY

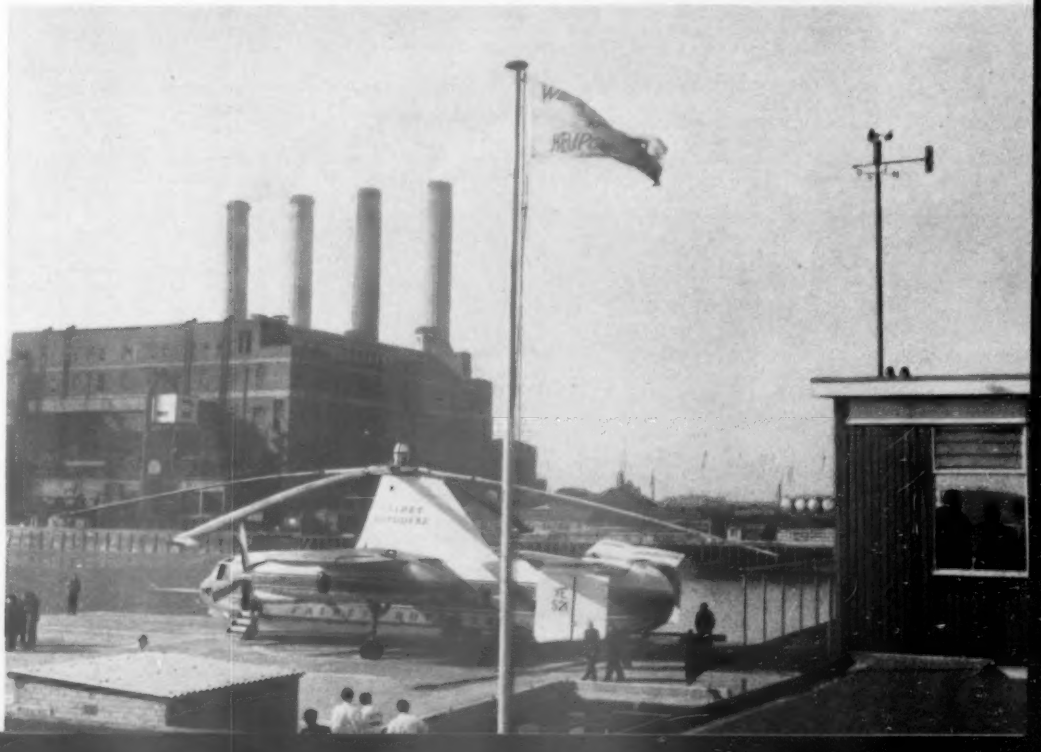
	British Aircraft	U.S. and Canadian Aircraft	French Aircraft	Dutch Aircraft	Others
British Airlines	268	15	—	—	—
North American Airlines ..	165	584	20	47	—
Central and South American Airlines	51	13	2	7	—
European Airlines	69	116	83	23	26+
African Airlines	41	7	10	3	8
Asian Airlines	55	27	—	19	?
Australasian Airlines ..	27	23	—	28	—
	676	785	115	127	34+

This table includes all firm airline orders for turbine-powered transports to date. Options, letters of intent, military orders, non-scheduled airline orders, business aircraft, conversions and prototypes are excluded. Comet 1 orders have not been counted. All F-27 orders are included as Dutch. No details are available of the Aeroflot turbine fleet, believed to total at least 250 Tu-104, Tu-114, Il-18 and An-10; quantities of Il-18 exported are also uncertain.

Of the total of 1,700 British, U.S., Canadian, Dutch and French airline transports listed in this table, more than half are powered by British aero-engines. The total of 968 British-powered aircraft (902 of these have Rolls-Royce engines) includes 676 of British origin, plus all the French, Dutch and Canadian aircraft included in the list, and 58 U.S.-designed transports. Rolls-Royce aero-engines have had additional success in powering the Grumman Gulfstream, the executive models of the Fokker F-27 (not counted in the totals quoted above) and, prospectively, the Japanese YS-11; in all, over 1,000 commercial transport aircraft have now been purchased with Rolls-Royce turbine engines.

Lest it should be concluded from the foregoing discussion that the production and sale of turbine transports is an easy or lucrative business, it should be recorded here that only two manufacturers appear, to date, to have sold sufficient quantities of a single design to have written off development costs and made a genuine profit; these are Vickers with the Viscount and Boeing with the 707/720. The problem for other manufacturers has not only been one of selling the original target quantity of aircraft but also of hopelessly inflated development costs.

Every turbine transport developed to date has encountered problems of a more or less serious nature either before or after its entry into service. In the case of the DC-8, with its original performance deficiency, the Electra with its structural failures and the Convair 990 with its aerodynamic and structural problems, the effect on the manufacturers may prove near disastrous. Douglas has written off $292 million on DC-8 development and seems to have no hope of recovering this



For an evaluation of noise levels at London's heliport, last month, the Westland/Fairey Rotodyne became the largest transport aircraft ever to land in a city centre. Such operations with 40-50 seat helicopters may become commonplace in five years' time. Meantime the future of Rotodyne itself is looking much more promising.

Commercial Aircraft . . . .

sum on future DC-8 sales; Lockheed reports a net loss of $58 million on the commercial Electra programme, which can perhaps be partially recovered by sales of the Naval P3V version; Convair last year wrote off $96.5 million in respect of the 880/990 programme, and further expenses will be involved in the current programme of modifications to the 990. Boeing wrote off $160 million against 707 development, but stands a reasonable chance of recovering this sum on unfulfilled orders.

Fairchild closed down its F-27 line with less than 100 produced—well below the break-even figure. The Canadair 540 has not found a commercial market and Napier's expenses in developing and certificating (in the U.S.) the Eland-Convair conversion can hardly have been recovered by the sale of fewer than 100 engines for such conversions, while Allison have done even less well with their turboprop version of the Convairliner. Sud-Aviation are still only half-way to the Caravelle break-even point.

It was not surprising in these circumstances to find the U.S. financial journal *Forbes* (as we quoted in our Feb. 24, 1961, issue) ridiculing the U.S. aircraft industry for spending $700 million to develop commercial airliners, the market for which could not be more than about $2,500 million-worth of aircraft.

Supersonic Programmes

Despite the considerable publicity now being given to development of a supersonic transport, there are signs that the U.S. industry has learnt its lesson with the subsonic types, all of which were developed without (direct) military support. Most of the pressure towards a supersonic programme is being directed by the U.S. industry at the Government rather than the airlines, using the catchphrase of national prestige and the bogy of superior Russian technology as levers to obtain Congressional sympathy for a State-sponsored programme.

Boeing, Convair, Douglas, Lockheed and North American have been principally concerned in this effort, with General Electric and Pratt & Whitney interested in the powerplant side. All five airframe manufacturers have spent considerable sums of their own money in project studies and basic research, which is likely to be taken a stage further in the near future in a $10-million F.A.A. development programme. This programme would presumably centre on a feasibility study of the kind already completed in Britain, and as a result of which the British Aircraft Corporation won a £350,000 design study contract last October for further development of their Mach 2.2 narrow delta.

The prospects for the supersonic airliner are still uncertain, but a recent Market Analysis by Convair, which is based on the latest available traffic trends, suggests that a Mach 3, 130-seat airliner will eventually carry 60% of all the Free World's traffic on greater than 1,000-mile ranges. The total requirement by 1975 is likely to be for 150 aeroplanes, which would cost $14.1 million each if built by a single manufacturer. Division of the programme between manufacturers would increase this unit cost significantly and above $23 million per aircraft the SST would be uneconomic to the airlines. To finance the $500-million development programme, an interest-free Government loan is required, to be repaid as production deliveries are made.

There is little doubt that an SST will be built within the next decade, although its prospective advent seems to be received by the airlines with no marked enthusiasm. The first concerted effort by the operators to express an opinion on supersonic travel possibilities will be made this month by the IATA Technical Committee at its meeting in Montreal.

Boeing's decision last December to put the three-engined Boeing 727 into production will have far-reaching consequences. It was facilitated by $350 million-worth of orders from Eastern Air Lines and United Air Lines. Mr. William M. Allen (centre), Boeing president, was understandably happy when this picture was taken.

Freighting

Rather more optimism can be expressed in respect of air freighting; in this field the U.S.A.F.'s selection of the Lockheed C-141 last month represents a significant milestone. The C-141, developed to meet the SOR 182 requirement for a strategic airlift jet freighter, has been designed to joint U.S.A.F./F.A.A. specifications in an attempt to meet both military and commercial requirements. Since the initial military requirement for 132 C-141s represents a $1,000-million investment in aircraft and associated ground-support equipment, it can be expected that any compromises between military and civil needs will tend to favour the military. Nevertheless, initiation of this programme is perhaps the biggest single step yet taken towards providing a true commercial air freighter with sufficiently low ton-mile costs (thanks to its turbofan engines) to permit the air-freight break-through which has been just around the corner for the past 10 years.

Availability of the C-141 for commercial use by 1965 inevitably influences the sales prospects of the turboprop Short Britannic of similar capacity, but Britain's Argosy, in service since the turn of the year, is more favourably placed in the rather more specialized, shorter-haul category. The Canadair Forty-Four, to enter service later this summer, should also contribute to the opening up of large-scale air freighting over long ranges.

Rotary Wing Aircraft

Developments in the commercial helicopter and VTOL field in the past 12 months have been virtually nil, with no new types in service and no new designs put into production. The year has seen, however, the first flights of the Vertol 107-II and the Sikorsky S-61, which, later this year, will become the first twin-turbine helicopter in scheduled service and may eventually, perhaps, provide a basis for non-subsidized helicopter transportation in high traffic density areas. Some flight development of the Westland Rotodyne has continued but the future of this impressive project has still to be assured by the Government; meanwhile the company has the Bristol 194 available for development as an alternative to the Rotodyne, but has discontinued the Westminster. Only in Britain and America is a serious attempt being made to develop the helicopter for economic commercial use, although the wide-scale introduction of helicopter services in Russia may lead eventually to the development there of more economic types than those at present in use.—P.G.S.

Like the Boeing 727, the British Aircraft Corporation BAC-107 is rear-engined with turbofans, and is also on the point of being put into production, in the form shown here or in the slightly larger BAC-111 version.

Commercial Aircraft . . . .

Turbine Transport Order Book

This listing records the firm airline orders to date for turbine-powered transports, including (in italics) airline purchases which are no longer current, military orders and prototypes.

CUSTOMER	QUANTITY* Firm	QUANTITY* Opt.	FIRST DELIVERY	FIRST SERVICE
ALLISON CONVAIR				
Corporate	*18*	—	*Sept. 1960*	—
Prototype	*1*	—	*Jan. 1960*	—
ANTONOV AN-10				
Aeroflot		—	1958	July 1959
Aeroflot (An-10A)		—	1959	Feb. 1960
AVRO 748				
Skyways	3	—	Sept. 1961	Mar. 1962
B.K.S.	5	—	1961	1962
Aden Airways (Srs. 2)	3	—	1962	1962
Aerolineas Argentinas	9	5	Oct. 1961	1962
Indian Air Force	*4*	—	*1961*	*1961*
Prototypes	*2*	—	*June 1960*	—
A.W. ARGOSY				
Riddle	7	7	Dec. 1960	Jan. 1961
B.E.A.	—	3	1962	1962
R.A.F.	*56*	—	*Mar. 1961*	*1961*
Prototypes, etc.	*3*	—	*Jan. 1959*	—
BOEING 707				
P.A.A. (–121)	6	—	Aug. 1958	Oct. 1958
National (–121)[1]	—	—	*1958*	*Dec. 1958*
American (–123B)[2]	24	—	June 1960	May 1961
T.W.A. (–131)	15	—	Jan. 1959	Mar. 1959
Continental (–124)	4	1	April 1959	June 1959
Northeast (–131)[3]	—	—	1959	Sept. 1959
Avianca (–121)[3]	—	—	1960	Oct. 1960
Qantas (–138B)[4]	10	—	1961	1961
Western (–139)[5]	2	—	April 1960	June 1960
Braniff (–227)	5	—	Dec. 1959	Dec. 1959
P.A.A. (–321)[6]	25	—	July 1959	Aug. 1959
T.W.A. (–331)	12	—	Oct. 1959	Nov. 1959
Air France (–328)	20	—	Oct. 1959	Jan. 1960
Sabena (–329)	5	—	Dec. 1959	Jan. 1960
Pakistan Intnl. (–321)[7]	1	—	1960	Mar. 1960
S.A.A. (–344)	3	—	July 1960	Oct. 1960
Persian Air Services (–329)[8]	—	—	—	1960
Royal Air Cambodge (–328)[9]	—	—	—	Jan. 1961
P.A.A. (–321B)	5	5	Mar. 1962	1962
Lufthansa (–430)	5	—	Feb. 1960	Mar. 1960
B.O.A.C. (–436)	15	3	April 1960	May 1960
Air India (–437)	6	—	Feb. 1960	April 1960
Varig (–441)	2	—	July 1960	—
El Al (–458)[7]	3	—	May 1961	July 1961
Ghana (–420)	2	—	July 1962	1962
U.S.A.F. (VC–137A)	*3*	—	*May 1959*	*May 1959*
Prototype (–80)	*1*	—	*July 1954*	—
BOEING 720				
United (–022)	29	12	April 1960	July 1960
American (–023B)[10]	25	—	1961	Mar. 1961
Irish Air Lines (–048)	3	1	Nov. 1960	Dec. 1960
Capitol (—022)[11]	*2*	—	—	*Jan. 1961*
Lufthansa (–030B)	8	—	April 1961	May 1961
Western (–047)	4	5	April 1961	—
Braniff (–027)	3	1	Feb. 1961	—
Eastern (–025)	15	—	1961	1961
Avianca (–059B)	2	—	1961	1961
Ethiopian (–060B)	2	—	1961	1961
Northwest (–020B)	6	6	June 1961	July 1961
F.A.A. (–027)	*1*	—	*1961*	—
BOEING 727				
United	40	—	1963	1964
Eastern	40	—	1963	1964
Lufthansa	—	12	1964	1964
BRISTOL BRITANNIA				
B.O.A.C. (102)	15	—	Dec. 1955	Feb. 1957
Aeronaves (302)	2	—	Nov. 1957	Dec. 1957
British United (307/317)[12]	4	—	Sept. 1958	Oct. 1958
Transcontinental (308)	2	—	Dec. 1959	Jan. 1960
Ghana (309/319)	2	—	Aug. 1960	Dec. 1960
B.O.A.C. (312)	18	—	Sept. 1957	Dec. 1957
El Al (313)	4	—	Sept. 1957	Dec. 1957
C.P.A. (314)	6	—	April 1958	June 1958
Cubana (318)	4	—	Dec. 1958	Jan. 1959
Cunard Eagle (318/324)[13]	3	—	April 1960	April 1960
R.A.F. (252/253)	*23*	—	*June 1959*	*June 1959*
Prototypes	*3*	—	*Aug. 1952*	—

CUSTOMER	QUANTITY* Firm	QUANTITY* Opt.	FIRST DELIVERY	FIRST SERVICE
CANADAIR CL-44				
Seaboard and Western	5	5	June 1961	July 1961
Flying Tiger	10	—	May 1961	July 1961
Slick	2	4	Sept. 1961	Nov. 1961
R.C.A.F. (CC–106)	*12*	—	*Nov. 1959*	—
CANADAIR 540 (AND ELAND-CONVAIR)				
Allegheny[14]	5	10	June 1959	July 1959
R.C.A.F. (CC–109)	*10*	—	*1960*	*1960*
Quebecair[15]	2	—	Dec. 1960	Dec. 1960
Prototypes	*4*	—	*June 1956*	—
CONVAIR 880				
T.W.A. (–22)	20	—	May 1960	Jan. 1961
Delta (–22)	13	—	Feb. 1960	May 1960
Northeast (–22)	6	—	Dec. 1960	Dec. 1960
C.A.T. (–22M)	1	—	June 1961	1961
VIASA (–22M)	2	—	June 1961	1961
J.A.L. (–22M)	5	—	1961	Oct. 1961
Hughes Tool Co. (–22)	4	—	1961	—
F.A.A. (–22M)	*1*	—	*1961*	*1961*
CONVAIR 990				
American	25	25	1961	1961
Swissair	5	6	1961	1961
S.A.S.	4	—	1961	1961
Real Aerovias	3	—	1961	1961
DE HAVILLAND COMET				
B.O.A.C. (1)	9	—	*Dec. 1951*	*May 1952*
U.A.T. (1A)	3	—	*Dec. 1952*	*Feb. 1953*
C.P.A. (1A)	2	—	*Feb. 1953*	—
Air France (1A)	3	—	*June 1953*	*Aug. 1953*
R.C.A.F. (1A)	2	—	*May 1953*	*1953*
R.A.F. (2)	*13*	—	*1956*	*1956*
B.O.A.C. (4)	19	—	Sept. 1958	Oct. 1958
Aerolineas Argentinas (4)	6	—	Mar. 1959	April 1959
E.A.A.C. (4)	39	—	1960	Sept. 1960
B.E.A. (4B)	14	—	Nov. 1959	April 1960
Olympic (4B)	4	—	April 1960	May 1960
Mexicana (4C)	1	1	Jan. 1960	—
United Arab (4C)	5	—	Mid 1960	July 1960
M.E.A. (4C)	4	1	Dec. 1960	Jan. 1961
Guest Aerovias (4C)[16]	2	—	—	Mar. 1961
Prototypes	*4*	—	*July 1949*	—
R.A.F. (4C)	*5*	—	*1961*	*1961*
DE HAVILLAND TRIDENT				
B.E.A.	24	10	Mid 1963	1964
DOUGLAS DC-8				
United (10)	22	—	June 1959	Sept. 1959
Delta (10)	6	—	July 1959	Sept. 1959
United (20)	15	—	Feb. 1960	—
Eastern (20)	16	—	Feb. 1960	Feb. 1960
National (20)	3	—	Feb. 1960	Feb. 1960
J.A.L. (30)	5	—	—	Aug. 1960
K.L.M. (30)	7	—	Mar. 1960	April 1960
Northwest (30)	5	—	1960	July 1960
P.A.A. (30)	19	—	Feb. 1960	April 1960
Panagra (30)	4	—	1960	—
Panair do Brasil (30)	2	—	Mar. 1961	Mar. 1961
S.A.S. (30)	7	—	April 1960	May 1960
Swissair (30)	4	—	April 1960	May 1960
T.A.I. (30)	3	—	June 1960	Sept. 1960
U.A.T. (30)	2	—	June 1960	Sept. 1960
VIASA (30)[10]	—	—	1961	April 1961
Philippine Air Lines (50)	2	—	Late 1960	1961
Alitalia (40)	10	—	1960	June 1960
T.C.A. (40)	11	2	Feb. 1960	April 1960
C.P.A. (40)	4	—	Early 1961	May 1961
K.L.M. (50)	6	—	1961	1961
Iberia (50)	3	—	Early 1961	June 1961
Aeronaves (50)[17]	1	—	Oct. 1961	1961
Prototype	*1*	—	*May 1958*	—

Continued on page 398

* Aircraft on long-term lease are listed under lessee and subtracted from lessors' fleets.

[1] Leased from Pan American.

[2] American bought one 707–120B and is converting 23 707–123 to turbofan power. First 707–123 delivered Oct. 1958, in service Jan. 1959; two destroyed before conversion.

[3] Leased from T.W.A.

[4] Includes seven 707–138 for conversion to "B" in 1961; first was delivered June 1959 and in service July 1959.

[5] Ordered by Cubana and leased from Boeing.

[6] Includes six 707–331 originally ordered by T.W.A.

[7] Service began Jan. 1961 with 707–441 leased from Varig.

[8] Leased from Sabena.

[9] Leased from Air France.

[10] Includes 10 delivered as –023 for later conversion, in service from July 1960.

[11] Leased from United prior to merger.

[12] Dates for Air Charter 307s; two Hunting Clan 317s in service May 1959.

[13] 318 leased from Cubana; 324s bought from C.P.A., March/May 1961.

[14] Dates for Napier prototype on lease.

[15] Services began Sept. 1960 with leased 540 demonstrator.

[16] Leased from Mexicana.

[17] Aeronaves purchased one Srs. 20 from Eastern, began service Dec. 1960.

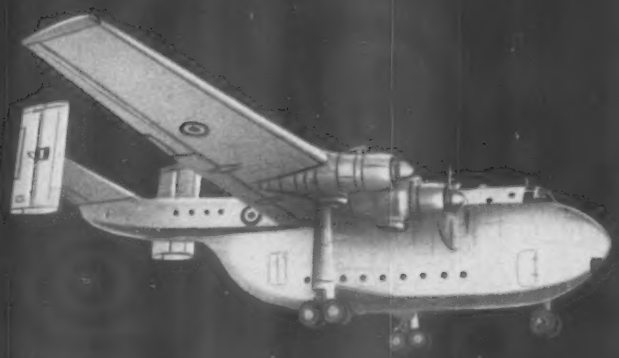
[18] Leased from K.L.M.

Commercial Aircraft . . . .

CUSTOMER	QUANTITY* Firm	QUANTITY* Opt.	FIRST DELIVERY	FIRST SERVICE
(Continued from page 397)				
FAIRCHILD F-27				
Avensa	5	3	Sept. 1958	Oct. 1958
Aloha	6	—	May 1959	June 1959
Bonanza	10	—	Feb. 1959	Mar. 1959
Ecuatoriana	1	1	1960	1960
Northern Consolidated (F-27B)	3	—	Oct. 1958	Nov. 1958
Ozark	3	2	—	—
Pacific Airlines	6	—	Mar. 1959	April 1959
Piedmont	8	—	Oct. 1958	Nov. 1958
Quebecair	3	1	Sept. 1958	Oct. 1958
Trans Mar de Cortes	1	1	Dec. 1958	1959
Turkish Airlines[1]	5	—	Aug. 1960	1960
West Coast	6	—	Aug. 1958	Sept. 1958
Wien Alaska	2	—	June 1959	July 1959
Corporate	24	—	—	—
Unsold	10	—	*1961*	—
FOKKER F-27				
Aer Lingus	7	—	Nov. 1958	Dec. 1958
All Nippon Airways	6	5	Jan. 1961	May 1961
Ansett-A.N.A. (F-27A)	9	—	Oct. 1959	Nov. 1959
Braathens	4	—	Dec. 1958	Jan. 1959
East-West (F-27A)	1	—	July 1959	Aug. 1959
Indian Airlines	5	5	April 1961	1961
K.L.M.	2	—	May 1960	—
MacRobertson Miller (F-27A)	1	—	Dec. 1959	Dec. 1959
Pakistan International[2]	5	3	Jan. 1961	Feb. 1961
N.Z.N.A.C.	8	3	Dec. 1960	Dec. 1960
Philippine Air Lines	3	—	Mar. 1960	1960
T.A.A. (F-27A)	9	—	April 1959	May 1959
Turkish Airlines[1]	5	—	1960	1960
Sudan Airways (F-27A)	3	—	1961	—
R. Neth. A.F.	12	—	*1960*	*1960*
Corporate and executive	12	—	—	—
Prototypes	2	—	*Nov. 1955*	—
GRUMMAN GULFSTREAM				
Corporate	56	—	*June 1959*	*1959*
HANDLEY PAGE HERALD				
B.E.A. (100)	3	—	1961	1961
Jersey Airlines (200)[3]	6	—	1961	1961
North-South (100)	1	—	April 1961	1961
M.C.A./Nordair (200)	2	6	1961	1961
Prototypes	2	—	*Mar. 1958*	—
ILYUSHIN IL-18				
Aeroflot	?	—	1958	April 1959
C.S.A.	6	—	Jan. 1960	April 1960
D.L.H. (Interflug)	5	—	1960	April 1960
Malev	4	—	May 1960	May 1960
Tarom	4	—	1960	1960
China	?	—	1960	1960
Ghana	6	—	Dec. 1960	Jan. 1961
Air Guinée	2	—	—	Jan. 1961
LOT	3	—	1961	1961
Air Mali	?	—	1961	1961
LOCKHEED ELECTRA				
American	32	—	1958	Jan. 1959
Ansett-A.N.A.	3	—	—	Mar. 1959
Braniff	9	—	—	July 1959
Cathay Pacific	2	—	April 1959	April 1959
Eastern	40	—	Oct. 1958	Jan. 1959
Garuda	3	—	Jan. 1961	1961
K.L.M.	11	—	Sept. 1959	Dec. 1959
National	15	—	—	April 1959
Northwest	18	—	July 1959	Aug. 1959
Pacific Southwest	4	—	Nov. 1959	Nov. 1959
Qantas	4	—	Nov. 1959	Dec. 1959
TEAL	3	—	Nov. 1959	Dec. 1959
T.A.A.	3	—	—	Nov. 1959
Western	12	—	—	Aug. 1959
Air Ceylon[4]	1	—	—	Oct. 1960
Real Aerovias[5]	3	—	Mar. 1961	1961
F.A.A.	1	—	*Jan. 1961*	—
Prototypes, etc.	4	—	*Dec. 1957*	—
LOCKHEED JETSTAR				
Corporate, etc.	26	—	*May 1961*	*July 1961*
U.S.A.F./U.S.N.	13	—	*1961*	*1961*
Prototypes	2	—	*Sept. 1957*	—
MAX HOLSTE SUPER BROUSSARD				
Ansett-A.N.A.	—	6	1961	1961
East-West	—	4	—	—
MacRobertson Miller	—	2	—	—
Prototypes	2	—	*Spring 1960*	—
NIPPON YS-11				
Prototypes	2	—	*Oct. 1961*	—
S.A. CARAVELLE				
Air France (III)[6]	33	—	Mar. 1959	May 1959
S.A.S. (I/IA/III)	14	4	April 1959	May 1959

CUSTOMER	QUANTITY* Firm	QUANTITY* Opt.	FIRST DELIVERY	FIRST SERVICE
S.A. CARAVELLE—Contd.				
Varig (I)	2	—	Sept. 1959	Dec. 1959
Air Algerie (I/IA/III/VI)	6	—	Dec. 1959	Jan. 1960
Finnair (IA/III)	4	1	Feb. 1960	April 1960
Royal Air Maroc (IA/III)	2	—	Mar. 1960	May 1960
Swissair (III)[7]	8	—	April 1960	May 1960
Alitalia (III/VI)	14	—	April 1960	May 1960
Air Liban (III)[8]	1	—	—	Dec. 1960
Tunisair (III)[8]	1	—	—	—
Sabena (VI)	6	—	Jan. 1961	Feb. 1961
United (VIR)	20	20	April 1961	July 1961
Iberia (VIR)	4	—	1962	1962
Prototypes (I/III)	4	—	*May 1955*	—
TUPOLEV TU-104				
Aeroflot (Tu-104)	?	—	1956	Sept. 1956
Aeroflot (Tu-104A)	?	—	1958	1958
C.S.A. (Tu-104A)	4	—	1957	Dec. 1957
Aeroflot (Tu-104B)	?	—	1959	Spring 1959
TUPOLEV TU-114				
Aeroflot	?	—	1959	1961
VICKERS VC10				
B.O.A.C.[9]	45	10	June 1963	1963
Ghana Airways	3	—	1964	—
Prototype	1	—	*Jan. 1962*	—
VICKERS VANGUARD				
B.E.A. (951)	6	—	Dec. 1960	Dec. 1960
B.E.A. (953)	14	4	1961	1961
T.C.A. (952)	23	4	Dec. 1960	Feb. 1961
Prototype	1	—	*Jan. 1959*	—
VICKERS VISCOUNT 700				
Air France (708)	5	—	May 1953	Sept. 1953
Aer Lingus (707)	4	—	*Mar. 1954*	*May 1954*
Air Vietnam (708)	2	—	Jan. 1961	Jan. 1961
Alitalia (785/745)	15	—	Mar. 1957	May 1957
All Nippon Airways (744)[10]	2	—	July 1960	1960
Ansett-A.N.A. (747)[12]	2	—	Sept. 1958	Sept. 1958
Austrian Airlines (745)	2	—	1961	1961
B.E.A. (701)	27	—	Jan. 1953	April 1953
British United (736)[10]	2	—	—	Jan. 1958
B.W.I.A. (702/772)	5	—	July 1955	Sept. 1955
Butler (747)	2	—	*Sept. 1955*	*Nov. 1955*
Capital (745)	52	—	June 1955	July 1955
C.A.A. (748/754)	6	—	May 1956	June 1956
Cubana (755)	3	—	*May 1956*	*June 1956*
Cunard Eagle (755)	2	—	Mar. 1961	1961
Cunard Eagle (Bahamas) (707)	2	—	Feb. 1960	Mar. 1960
Fred Olsen (779)	2	—	April 1957	—
Hong Kong Airways (760)	2	—	*Jan. 1957*	*Feb. 1957*
Hunting Clan (732)	3	—	*May 1955*	*June 1955*
Icelandair (759)	2	—	Nov. 1956	Mar. 1957
Indian Airlines (768)	10	—	Aug. 1957	Oct. 1957
Iranian Airways (782)	3	—	Mar. 1958	May 1958
Iraqi Airways (735/773)	4	—	Oct. 1955	Nov. 1955
Kuwait Airways (702/761)	2	—	1958	June 1958
Lanica (786)	4	—	*Jan. 1958*	*Feb. 1958*
L.A.V. (749)	—	—	Feb. 1956	Mar. 1956
Maitland Drewery (708)	3	—	June 1960	Oct. 1960
Malayan Airways (760)	2	—	1959	Aug. 1959
M.E.A. (732/754)	6	—	1955	Sept. 1955
Northeast (798)	10	—	1958	Sept. 1958
Philippine Air Lines (784/745)	4	—	May 1957	June 1957
P.L.U.N.A. (769)	3	—	May 1958	Sept. 1958
S.A.S. (779)[13]	2	—	—	—
Starways (708)	2	—	Mar. 1961	1961
T.A.C.A. (763/786)	3	—	—	Nov. 1957
T.A.A. (720/756)[12]	14	—	Oct. 1954	Dec. 1954
T.C.A. (724/757)	51	—	Dec. 1954	April 1955
Tradair (707)	2	—	Jan. 1960	Jan. 1960
Turkish Airlines (794)	5	—	Jan. 1958	May 1958
Union of Burma (761)	1	—	July 1957	Nov. 1957
United Arab (739/732)	8	—	Dec. 1955	Jan. 1956
Prototypes and non-airline	15	—	*July 1948*	—
VICKERS VISCOUNT 800				
Aer Lingus (808)	7	—	May 1957	June 1958
All Nippon Airways (828)	6	—	July 1961	—
Ansett-A.N.A. (832/812)	5	—	Feb. 1959	Mar. 1959
Austrian Airlines (837)	6	—	Feb. 1960	Mar. 1960
B.E.A. (802)	24	—	Feb. 1957	Mar. 1957
B.E.A. (806)	19	—	Mar. 1958	May 1958
B.U.A. (804/831/833)[11]	—	—	—	—
Cubana (818)	3	—	Nov. 1958	Aug. 1959
Continental (812)	13	—	May 1958	May 1958
Eagle (Bermuda) (805)	2	—	*Dec. 1957*	—
Ghana Airways (838)	3	—	May 1961	—
K.L.M. (803)	9	—	June 1957	July 1957
Lufthansa (814)	10	—	Oct. 1958	Dec. 1958
Maritime Central (805)	1	—	—	June 1959
N.Z.N.A.C. (807)	4	—	Dec. 1957	Feb. 1958
Pakistan Intnl. (815)	5	—	Jan. 1959	Feb. 1959
S.A.A. (813)	7	—	Oct. 1958	Dec. 1958
Sudan Airways (831)	1	—	June 1959	June 1959
T.A.A. (816)	2	—	May 1959	June 1959
V.A.S.P. (827)	6	—	Oct. 1958	Dec. 1958
Prototypes and non-airline	5	—	*Dec. 1957*	—

* Aircraft on long-term lease are listed under lessee and subtracted from lessors' fleets.
[1] Five each by Fokker and Fairchild.
[2] Includes one F-27B freighter.
[3] One Herald 100 leased from makers for service in May 1961.
[4] Leased from K.L.M.
[5] Purchased from American Airlines.
[6] Ten ordered as Series I, two as IA, later converted.
[7] Leased from S.A.S. for four years.
[8] Leased from Air France.
[9] Includes VC10 and Super VC10 derivative.
[10] Dates apply to Airwork operation.
[11] Dates apply to Transair 804s; Hunting Clan used 832s from June 1959 and Airwork took delivery of 831s in February 1959.
[12] Three 720 leased from T.A.A. by Ansett.
[13] Leased from Fred Olsen.
[14] Leased from makers, ex-Capital Airlines.



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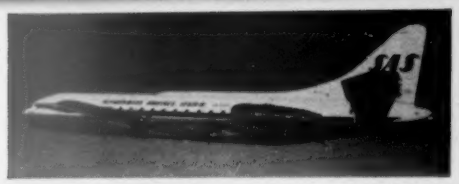

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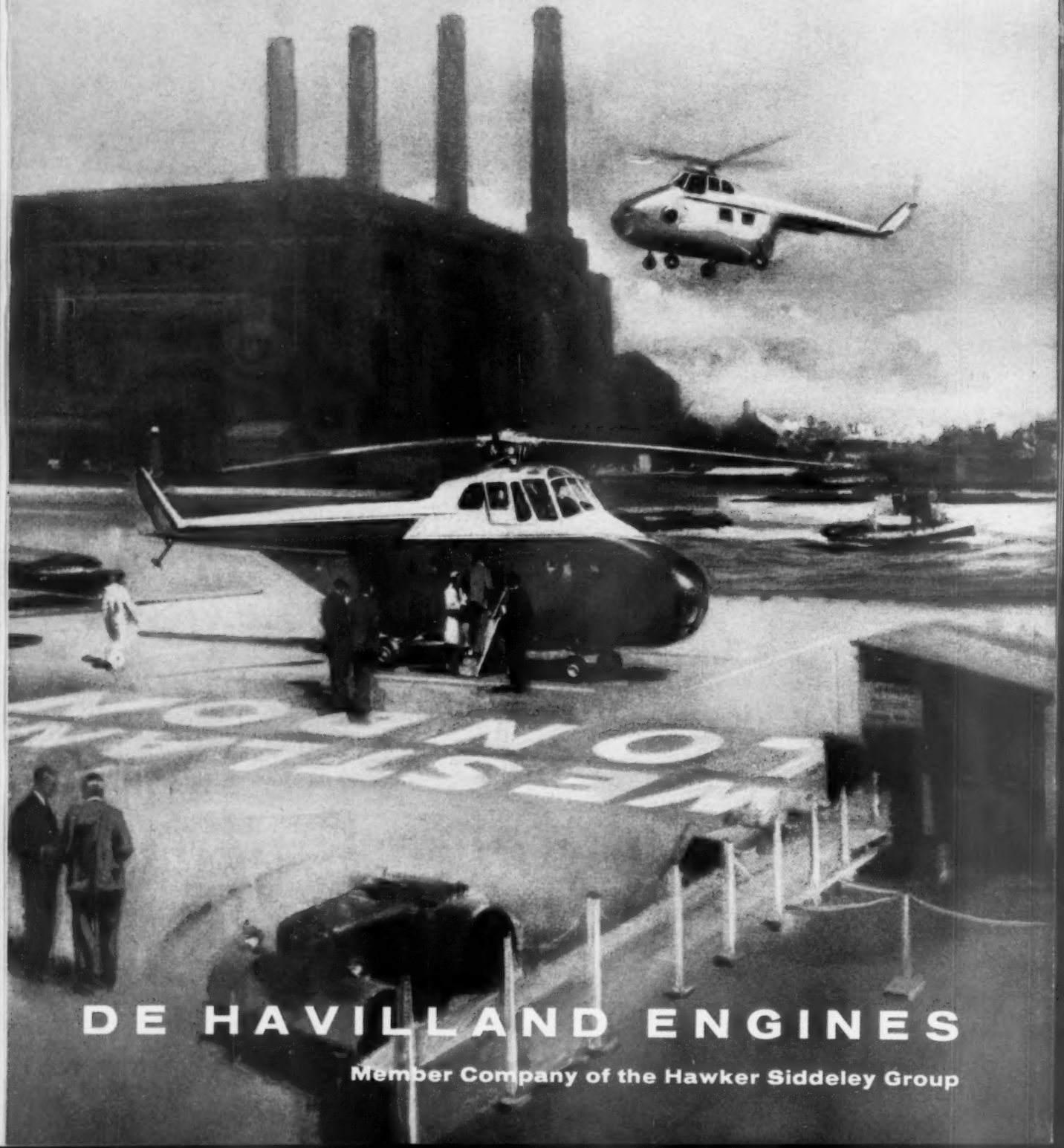

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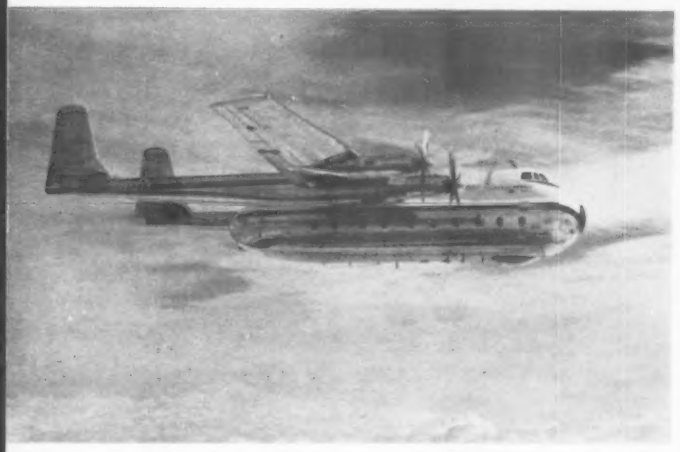
Commercial Aircraft . . . .

Turbine Transports of the World

ALLISON CONVAIR. Conversions of the Convair 340/440 family with Allison 501D-13 turboprops (Electra powerplants) have proved of principal interest to U.S. corporate owners. The Lake Central Airways plan to acquire five is temporarily in abeyance, but the total of 18 conversions made, or on order, includes five for the F.A.A.; 12 had been delivered by February, 1961. The prototype conversion flew on Jan. 19, 1960, and the type certificate was obtained in April. PacAero at Santa Monica is responsible for the conversion, which includes increased tailplane, fin and rudder area, and improved soundproofing. Optional tankage is available for a maximum range of 2,950 naut. miles with a 780-lb. payload.

ANTONOV AN-10A. This big Russian turboprop, designed for operation from short, unprepared fields, has been introduced on a number of new services in recent months, including several in the far North. The standard model is the An-10A with 100 seats, but cargo versions are also in service. Nothing has been heard recently of the projected An-16, with a 10-ft. longer fuselage for 130 passengers. A military version, with rear-loading ramp and a tail turret, is designated the An-12.



Armstrong Whitworth Argosy (Rolls-Royce Dart).

ANTONOV AN-24. Flight trials of this 32/40-seat twin-turboprop feederliner began in 1959 or early 1960 and it is expected to go into service with Aeroflot as an Il-14 replacement later this year. The design follows Antonov custom, with a high wing having anhedral on the outer panels. The engines are reported to be 2,000-s.h.p. units designed by Ivchenko and, at an estimated gross weight of 35,000 lb., the An-24 is in the same class as the Avro 748, Dart Herald and F-27. Cruising speed is reported to be 286 knots and the range about 1,000 naut. miles. Span is 88 ft. 7 in., length 80 ft. 4 in. and wing area 678 sq. ft.

ARMSTRONG WHITWORTH AW.650 ARGOSY. Since the beginning of this year the Argosy has been in service with Riddle Airlines, which has ordered seven and is the first operator of the type. Development up to this point, including construction of 10 examples, was a Hawker Siddeley Group private venture at an estimated cost of £15 million. Significant dates in the Argosy history are: Jan. 8, 1959, first flight; Feb. 23, 1959, provisional Riddle order announced; September, 1960, certification testing completed; December, 1960, award of British and U.S. type certificates and delivery of first Argosy (N6501R) to Miami; Jan. 15, 1961, first Argosy operation on Logair contract from Tinker A.F.B.; Feb. 23, 1961, first commercial freight service, Miami-San Juan daily return.

The makers have recently revised the AW.670 Air Ferry and 114-seat Airbus versions of the design, which has a new fuselage to provide a 58 ft. by 15 ft. by 7 ft. 1 in. hold for eight cars and 32 passengers. For high-frequency short-range operations, the undercarriage would be fixed. A 25,000-lb. payload could be carried for 140 naut. miles.

Antonov An-24 (Ivchenko turboprop).

AVRO 748. Route-proving trials with the first production model of this twin-Dart 40/48-seat feederliner should begin in the autumn, following certification in July. The prototype (G-APZV) flew on Jne. 24, 1960, 18 months after the project was announced, and has completed over 250 hr. of flight testing to date. A second prototype (G-ARAY) has recently joined the flight-test programme. Production of the first 10 (including one Series 2 with the bigger Dart R.Da.7s) is well advanced, and work on a further 50 has been authorized. The first and second production 748s should be at the makers' flight test airfield at Woodford by the end of this month.

Important events in the Avro 748 story have been its adoption by the Indian Air Force for construction at Kanpur (as the Avro 757 in a military version of the Series 2), orders from Skyways, B.K.S. and Aden Airways, Special Category C. of A. on Sept. 6, 1960, and, last month, the contract from Aerolineas Argentinas for nine Series 1s. An executive version, the 748X, has been planned, with extra fuel for a 2,250-mile range.

Above, Avro 748 (Rolls-Royce Dart).

Left, Antonov An-10A (Ivchenko AI-20).

Boeing 707-320 (Pratt & Whitney JT4A-9).

AVRO 758. This designation applies to a variant of the Avro 748 with a high wing and rear-loading doors suitable for air-dropping, which has been projected primarily for the Indian Air Force.

AVRO 761/771. Design studies have been made for a short-haul turbofan transport which Avro might undertake as a private venture. The 761 would have Rolls-Royce engines, and the 771 would have Bristol Siddeley BS75s; in other respects the projects are similar, with a low, swept wing, two rear-mounted engines and accommodation for about 60 passengers. (See our issue for Sept. 9, 1960.)

BOEING 707-120/120B. No new orders for the original 106/179-seat variant of the Boeing jet transport family (first flown Dec. 20, 1957) have been recorded in the past 12 months, but the turbofan-powered 120B has passed from first flight to scheduled service during the year. The first 707-120B flew on Jne. 22, 1960, and began its F.A.A. certification testing on Sept. 6. Some 320 flight hours later, at the beginning of March, 1961, the -120B was certificated for operation at 258,000 lb. gross weight, and entered service with American Airlines on Mar. 12. All but the first 707-120B are being produced for American Airlines by converting -120s to have the JT3D-1 turbofan engines, inner-wing leading-edge glove and additional Krueger-type leading-edge flaps.

The seven short-fuselage Qantas 707-138s are also to be converted to "B" standard, with the existing JT3C-6 engines converted to JT3D-1-MC6. Three more 707-138Bs to be built for Qantas are the only other aircraft of this type at present on order.

BOEING 707-220. Production of the 707-220, a domestic model with JT4A turbojets, was limited to five for Braniff Airways.

BOEING 707-320/320B. A few 144/189-seat 707-320s have still to be delivered, principally on re-orders from original customers. The -320, first flown on Feb. 15, 1959, was the first Intercontinental model, with longer fuselage, bigger wing and 15,800-lb. JT4A-3 turbojets. During the past year most existing 707s have been modified at Renton or by the airlines to have the 35-in. fin extension, ventral fin, and fully boosted rudder, and the 16,800-lb. JT4A-9 or 17,500-lb. JT4A-11 has been introduced.

In February, Boeing announced an order from Pan American for five 707-320Bs, described as the World's longest-range jet-liner with a 15% improvement over the -320. Dimensionally similar to the -320, but with a small wing-span extension, the "B" has 18,000-lb. JT3D-3 turbofans and improved leading- and trailing-edge flaps. The full-span leading-edge flaps will be hinged to have a slotted effect and the trailing edge will include a plain flap over the root fillet. Deliveries of this model are to begin in 1962. (See our issue for Dec. 2, 1960.)

BOEING 707-420. Production is continuing with the Conway-engined Intercontinental model, ordered by six airlines to date. The tail modifications, now standardized and retrofitted on all Boeing 707s, were first developed on the B.O.A.C. -420s during the early part of 1960, to improve the overall handling characteristics and control at low speeds. The 707-420 first flew on May 19, 1959, and was in service in March, 1960; B.O.A.C.'s fully modified 707-436 was certificated on Apr. 27, 1960.

BOEING 707-520B. For 1963-64 delivery, Boeing offer an enlarged 707, with a 12-ft. fuselage extension; inner-wing leading-edge glove; full-span slotted leading-edge flaps; partial flap blowing on the trailing edge; and P. & W. JT3D-5A or R.-R. Conway R.Co.42/2 turbofans. The gross weight would be about 350,000 lb. and the space-limited payload, 49,000 lb. Maximum range operation of the 707-520B would allow three-sector round-the-World flights to be made. (See our issue for Dec. 2, 1960.)

BOEING 720/720B. The medium-haul member of the Boeing jet family continues to sell well, particularly in its turbofan-powered "B" variant. Changes introduced on the 90/149-seat 720, which first flew on Nov. 23, 1959, were a shorter fuselage, inner segment leading-edge flaps, inner-wing glove, lighter undercarriage, lightweight JT3C-7 or JT3C-12 turbojets, taller fin and ventral fin. Three 720s were used in the certification programme, which started on Jan. 18, 1960; scheduled service began on Jly. 5, 1960.

The first 720B flew on Oct. 6, 1960, and was certificated early in March for services to begin on Mar. 12 by American Airlines. It differs from the 720 in having JT3D-1 turbofans and higher permissible gross weights.

BOEING 727. The most important event of 1960 in the transport aircraft field was Boeing's decision to go ahead with the triple-jet, short-medium-haul 88/120-seat 727—a decision that was made easier to reach by orders for 40 each from Eastern and United. Early this year Lufthansa became the first overseas customer for the 727 with an order for 12.

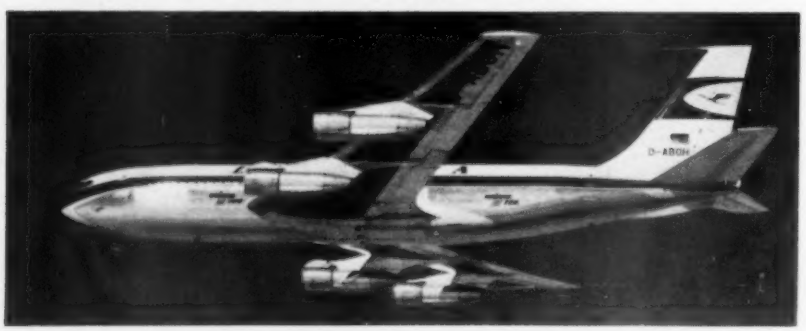
The 727 departs from the 707/720 family in the arrangement of its three 14,000-lb. P. & W. JT8D-1 turbofans at the rear—

Boeing 727 (Pratt & Whitney JT8D-1).

two in fuselage side pods, and one in the rear fuselage itself with a dorsal intake. The fuselage—of circular cross-section—is of the same diameter as the upper lobe of the 720 fuselage, however, and much tooling will be common to both. Many of the airframe accessories will also be common to the two types. Among the less conventional features of the design are the ventral airstairs giving main access to the cabin; a ventral fin to "provide a positive indication of the maximum rotation of the aeroplane for the shortest take-off distance," triple-slotted trailing-edge flaps and slotted and Krueger-type leading-edge flaps.

Boeing investigated 150 different designs over 4½ years and tunnel-tested 68 of these before deciding on the layout of the 727. Production is now being initiated at Renton, with the first metal to be cut in June and a first-flight target date of November, 1962. Three production aircraft will be used for the test programme and airline deliveries are expected to begin towards the end of 1963.

(*Continued on page 407*)



Boeing 720B (Pratt & Whitney JT3D-1).

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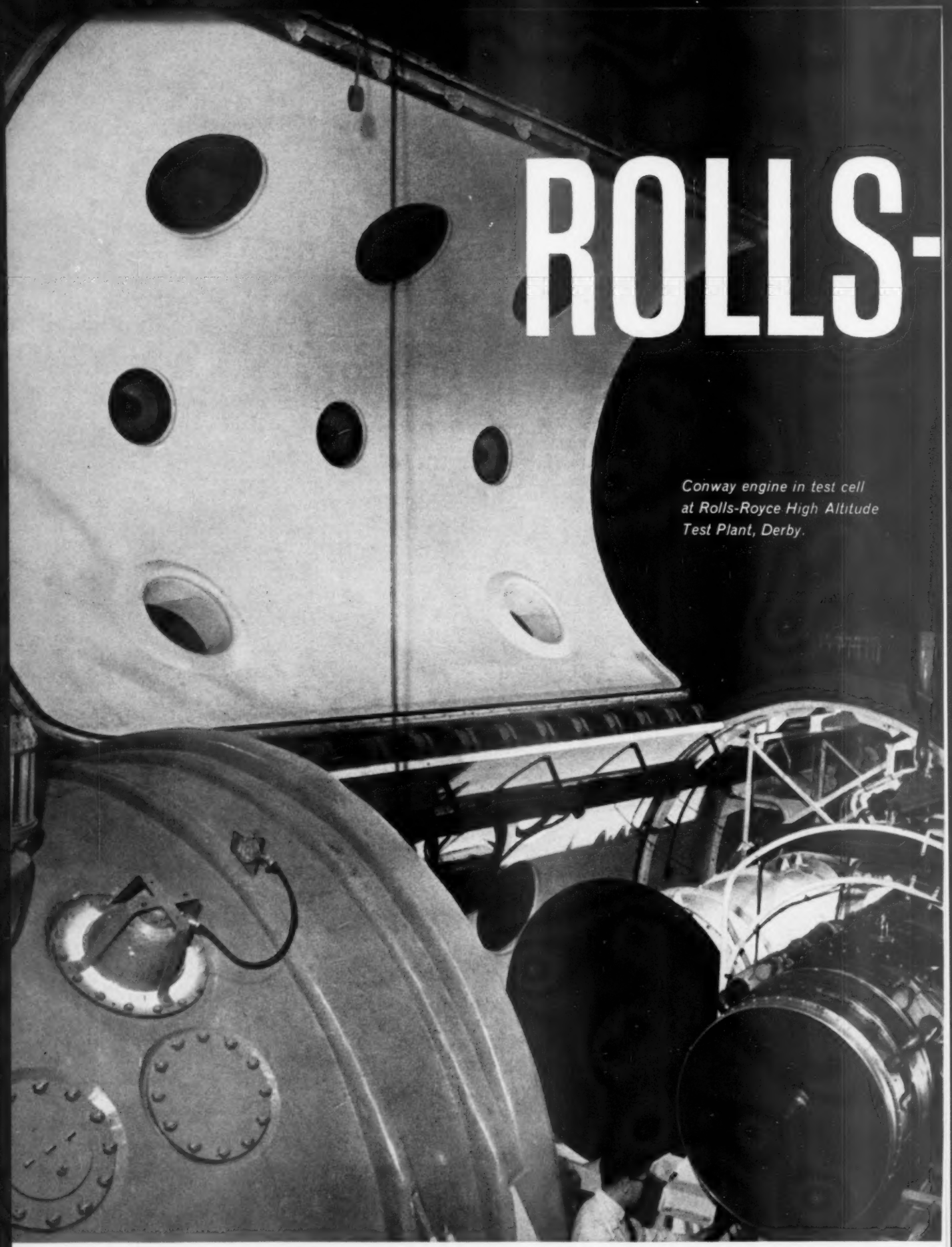

ROLLS-

Conway engine in test cell at Rolls-Royce High Altitude Test Plant, Derby.

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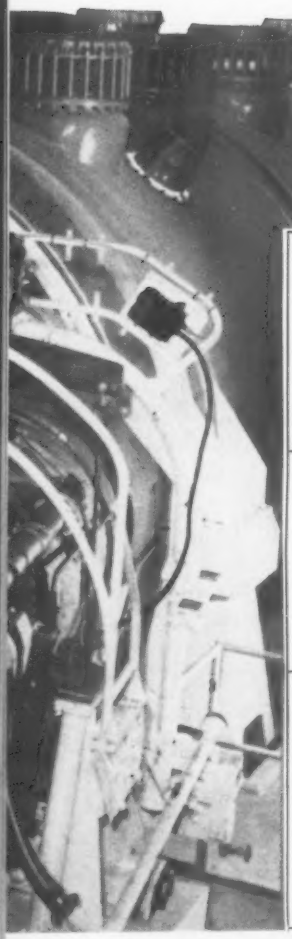
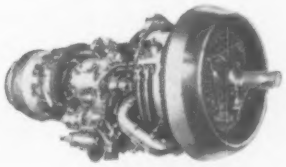


DART PROP-JET



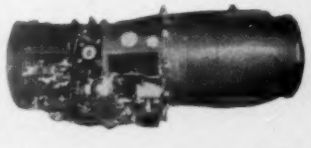
TYNE PROP-JET

ROLLS-ROYCE GAS TURBINES CHOSEN FOR

ARMSTRONG WHITWORTH ARGOSY · AVRO 748
BOEING 707-420 · CANADAIR FORTY-FOUR
DE HAVILLAND COMET · DE HAVILLAND TRIDENT
DOUGLAS DC-8 · FOKKER & FAIRCHILD F.27
GRUMMAN GULFSTREAM · HANDLEY PAGE DART HERALD
NAMC YS-11 · SUD-AVIATION CARAVELLE
VICKERS VANGUARD · VICKERS VISCOUNT
VICKERS VC.10

AVON TURBO JET

CONWAY BY-PASS JET



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IG	HYDRAULICS	ELECTRICS	DE-ICING
Godfrey	Duplicated 2,500–3,000 p.s.i. system powered by three pumps to operate u/c, nosewheel steering, brakes and flaps. Electric power pack for emergency use.	Four 6 kW. engine-driven generators for 28V. D.C.; two invertors for A.C. supply and three alternators for de-icing current.	Two exhaust heat exchangers provide hot air for wings; electric heaters for tail unit, engine intakes and propeller. Nesa glass windscreen.
dP 4.2	2,500 p.s.i. system powered by two pumps for u/c, brakes, nosewheel steering and optional propellier brakes (plus manual emergency pump for u/c).	Primary 28V. D.C. system for two engine-driven generators, plus two alternators for 115V. A.C. and a third alternator for 200V. A.C. for engine and propeller de-icing.	Wing and tail by chordwise rubber boots energized by engine-bleed air.
Two or engine-	Utility and auxiliary 3,000 p.s.i. systems, engine and electric pump-powered for u/c, brakes, flaps, spoilers and nosewheel steering.	Four 30 kVA. three-phase Westinghouse alternators for 115–200V. 400-cycle A.C. Rectifiers for 28V. D.C., and 36 amp.-hr. battery.	Wing and intakes anti-icing by engine-bleed air; de-icing mats on tail. Nesa glass windscreen.
itioning.	Dual system from two engine-driven pumps, for u/c, n/w steer, brakes, flaps, flying controls and rear airstairs.	Primary A.C. from three engine-driven generators with D.C. through transformer-rectifiers. Electric operation of forward airstairs.	—
rs. dP	Two Vickers Inc. pumps power main 3,000 p.s.i. system for u/c, brakes, nosewheel steer, cargo door and swing-tail operation, with emergency compressed-air system for u/c and brakes.	Westinghouse 40 kVA. three-phase 400-cycle alternators with Sundstrand drive for 115V. A.C. plus variable frequency A.C. from Westinghouse 60 kVA. generators and 28V. D.C. through rectifiers.	Thermal anti-icing of wing by ram-air passed over engine tail-pipes; tail unit by hot air from dual heater system; electric de-icing for intakes, propellers, screen and elevator horn balances.
turbo- ir. dP	Four Vickers Inc. engine-driven pumps for dual 3,000 p.s.i. system for flaps, u/c, spoilers, v.i. tailplane, brakes and n/w steering; flaps and spoilers operate from either system.	Four 40 kVA. General Electric engine-driven generators provide 115/208V. 400-cycle A.C.; four G.E. transformer-rectifiers for 28V. D.C. and Nickel Cadmium 28V. battery.	Wing and intakes anti-iced by engine-bleed air; electric tail unit de-icing; Nesa glass screen fog removal and air-blast rain removal.
engine- ground	Three independent 3,000 p.s.i. systems powered by three Vickers-Sperry pumps, with independent stand-by, to operate flying controls, u/c, brakes, flaps, droop l.e., slats, air brakes and lift dumpers.	Three B.T.H. A.C. generators for 400-cycle three-phase 115/200V. A.C. and, through three rectifiers, 28V. D.C.	Airframe de-icing, including engine and air intakes, by engine-bleed air. Electric film screen de-icing.
red by plicated r-cycle	Main 3,000 p.s.i. system from two Vickers Inc. engine-driven pumps and electrically driven pumps for auxiliary system, for u/c, flaps, power controls, n/w steering and brakes; separate electrically powered system for spoilers.	Four 20 kVA. engine-driven Jack and Heintz generators for three-phase 115/200V. 400-cycle constant frequency A.C. and four G.E. 50-amp. transformer-rectifiers for 28V. D.C.	Wings, tail unit and intakes by engine-bleed air; Nesa glass screen and air-blast rain removal.
ressors.	NO HYDRAULICS. Two independent 3,300 p.s.i. pneumatic systems with Dunlop engine-driven compressors for u/c, brakes and n/w steering.	24–28V. D.C. from two Bendix engine-mounted generators and secondary three-phase 115V. 400-cycle A.C. from two Bendix invertors. Jack and Heintz (D.C.) and Westinghouse (A.C.) accessories for U.S. models.	Wing and tail unit by Goodrich rubber boots. Electrical de-icing of intakes, propellers, spinners and windshield.
super- esearch ap air am air	Two N.Y. Air Brake engine-driven pumps for 1,500 p.s.i. system (Skydrol) for flaps, u/c, brakes, n/w steer, propeller brake, windscreen wipers and airstairs.	Two Jack and Heintz engine-driven generators for 28V. D.C. and two Leland 1,500 V.A. invertors; two Sonotone 24V. nickel-cadmium storage batteries.	B.F. Goodrich pneumatic boots for wings and tail; windscreen by electric elements.
.2 p.s.i.	3,000 p.s.i. system supplied by two Lockheed pumps, for u/c, flaps, n/w steering, brakes.	Two 28V. 6 kW. D.C. generators (one each engine). Four 24V. batteries for starting, general and emergency use.	Wing, fin and tailplane by hot air from engine exhaust heat exchanger. Electrical system for windscreen.
hrough	3,000 p.s.i. system with two NP-25 engine-driven pumps and two 2,100 p.s.i. stand-by nitrogen-charged accumulators for u/c, brakes, flaps, n/w steering and windscreen wipers.	Eight 12 kW. engine-driven generators for 24V. D.C., and four 8 kW. alternators and an invertor for single-phase A.C. and two invertors for 3-phase A.C.	Electro-thermal de-icing of wing, fin, tailplane, propellers, spinners and windscreen. Engine-bleed air for intake de-icing.
n com- two s. dP	Two independent 3,000 p.s.i. systems with three Vickers Inc. electrically driven pumps for power controls, flaps, u/c, brakes, n/w steering.	Four General Electric engine-driven 60 kVA. generators for 120/208V. 400-cycle 3-phase A.C., and two Westinghouse rectifiers for 28V. D.C.; 24V. battery.	Airframe de-icing by engine-bleed air. Electric de-icing for windscreen and propellers.
s. Two s.i.	Independent 3,000 p.s.i. systems from engine-driven pumps (auxiliary 2,300 p.s.i. systems from electric pump) for flaps, speed brake, u/c, brakes, elevators and control boost.	Two 400-amp. starter-generators and two 12V. batteries for D.C.; two 1,500 V.A. 3-phase invertors for D.C.; one 250 V.A. and one 100 V.A. transistorized invertor.	Pneumatic boots for wing and tail. Engine-bleed air for intakes. Hot air for windscreen.
ning by sound-	Hydraulic operation of flaps, undercarriage and brakes.	Two 6 kW. engine-driven generators and a 28V. 35 a.h. storage battery in the fuselage nose.	Goodrich-Kleber Colombes pneumatic wing and tail de-icing. Liquid protection of propellers.
cluding at dP om one	3,000 p.s.i. system for flaps, u/c, n/w steering, brakes, propeller brakes, windscreen wipers and ground cooling blower.	Two 12 kW. engine-driven generators and two 24 a.h. batteries for 28V. D.C. Two 25 kVA. and one 0.5 kVA. invertors and four 30 kVA. "frequency-wild" alternators.	Hot air wing and tail de-icing using combustion heaters. Electric de-icing of windscreen, propellers and intakes.
	—	Electric flap operation.	—
driven	Twin 2,500 p.s.i. systems (each with electrically powered stand-by) for flying controls, u/c, wheel brakes, flaps, spoilers, nosewheel steering, airstairs and feel simulators.	Two Auxilec engine-driven 30V. D.C. generators provide 28.5V. D.C. and 115V. 400-cycle A.C. through two invertors. 26V. A.C. available also through transformer.	Wings, tail unit and intakes by engine-bleed air.
s. De dP 6.55	British Messier 4,000 p.s.i. system for u/c, brakes, n/w steer, flaps, control ground locks and "q" feel. APU for ground operation.	Eight 50 kVA. engine-driven alternators for 200V. A.C. "frequency-wild" power and 28V. D.C. through transformer-rectifiers. A.P.U.-driven alternator for ground operation.	Wings by hot air from engine heat-exchanger; tail unit, spinners and intakes by electric elements.
lowers. dP 6.5	Duplicated 3,000 p.s.i. system powered by four engine-driven pumps for u/c, flaps, brakes, n/w steering, airstairs and propeller brakes.	Six Rotax variable frequency 50 kVA. alternators provide 208V. A.C. and, via four transformer/rectifiers, 28V. D.C. for main electrical demand.	Wings by engine heat exchangers. Alternator on Nos. 1 or 4 engine provides current for tail unit, Spraymats and Triplex windscreen. Electric cyclic for propellers, spinners and engines.
ressors. humidi- ergency	Two independent 3,000 p.s.i. systems for u/c, brakes, n/w steering, slats, flaps, spoilers and v.i. tailplane. Emergency ram-air turbine.	Plessey/Westinghouse electrical system with four 40 kVA. constant-speed engine-driven generators to give 115/200V. 400-cycle 3-phase A.C. Emergency ram-air turbo alternator. 28V. D.C. supply with split source.	Wing, tail and powerplant by engine-bleed air. Nesa glass windscreen.

AIRCRAFT	STRUCTURE	FUEL SYSTEM	UNDERCARRIAGE
ARMSTRONG-WHITWORTH ARGOSY	Semi-monocoque, open-ended fuselage. Two-spar mass boom wing in five sections. Twin tail booms.	Ten bag tanks between spars. Capacity 3,300 I.G. Two-point pressure refuelling at 300 g.p.m.	Dowty oleos, backwards retracting, with twin main and steerable nosewheels. Dunlop disc brakes and Maxarets. T: 32 ft. 6 in. B: 25 ft. 5 in. Tyre pressure 88 p.s.i.
AVRO 748	Circular-section fuselage. Two-spar wing in one piece each side, attaching to integral wing/fuselage centre-section. Principal materials L.65, L.72, L.73 and L.77 aluminium alloys.	One integral tank each wing. Capacity 1,100 I.G. Gravity refuelling (pressure optional).	Twin-wheel British Messier main legs retract forwards into nacelles. Steerable twin nosewheel folds forwards. T: 24 ft. 9 in. B: 20 ft. 1 in. Tyre pressure 40 p.s.i.
BOEING 707 INTERCONTINENTAL	Double-bubble semi-monocoque fuselage; close-spaced frames, stringers and skins of aluminium alloys. Two-spar wing in two main panels joined by fuselage-width centre-section; multi-panel tapered skins.	Three integral tanks in each wing and/or one in each root and bladder tank in centre-section. Capacity 11,280 I.G. (120); 19,607 I.G. (320/420); 9,780—13,400 I.G. (720). Four-point pressure refuelling at 1,500 U.S. g.p.m.	Four-wheel bogie main units, inwards retracting and twin-wheel steerable nosewheel; anti-skid units fitted. T: 22 ft. 1 in. B: 59 ft.
BOEING 727	Semi-monocoque circular-section fuselage with Z-section frames and top-hat stiffeners. Two-spar wing assembled as one piece, through fuselage. Spars carry shear loads; skins and stringers carry banding loads.	Integral tanks in wing torsion box. Capacity 5,829 I.G. Pressure refuelling.	Loud Manufacturing main oleos retract sideways into fuselage; Menasco steerable nose oleo retracts forwards; twin wheels on all units. Nosewheel brake and main wheel anti-skid units. T: 18 ft. 9 in. B: 53 ft. 3 in.
CANADAIR CL-44D	Circular-section semi-monocoque fuselage with hinged tail. Two-spar wing in two main units joined at fuselage centre-line. Stiffened, stress-carrying upper and lower skins. Principally 2075–T and 2024–T.	Six-bay integral tanks in wings; capacity 8,520 I.G. Optional six-cell bag tank in centre-section; capacity 1,620 I.G. Pressure refuelling at 500 U.S. g.p.m.	Four-wheel bogie main units, backwards retracting, and steerable twin-wheel nosewheel. Hydraulic brakes. Bendix anti-skid. T: 31 ft. B: 49 ft. 11 in. Tyre pressure 160 p.s.i.
CONVAIR 880/990	Quasi-elliptical section fuselage with heavy-gauge 2024 alloy skin. Three-spar wing with built-up spars and machine-tapered skins; 2024–T4 lower skin, 7075 upper skin.	Two integral tanks in each wing give basic 880 capacity of 8,970 I.G.; centre-section tanks in 880-M to give capacity of 10,508 I.G.; shock-body tanks in 990 to give capacity of 13,049 I.G. Four-point pressure refuelling at 1,000 g.p.m.	Cleveland oleos for four-wheel main bogies, inwards retracting. Twin-wheel steerable nosewheel, forwards retracting. Goodyear (880) or Bendix (880-M, 990) wheels and brakes, Hydro-Aire anti-skid (proportional on 880-M, 990). T: 18 ft. 10½ in. B: 52 ft. 11 in. Tyre pressure 120–140 p.s.i.
DE HAVILLAND TRIDENT	Circular-section monocoque fuselage. Two-spar wing with third spar over centre-section and inner wings. Naturally aged Al-Cu alloys for skins and stringers.	Two-bay integral tank in each wing. Optional centre-section tank. Capacity 3,840 I.G.	Four-abreast main wheel units pivot through 90° and fold sideways. Offset Automotive Products n/w folds sideways. Dunlop wheels, tyres, brakes. T: 19 ft. 1 in. B: 44 ft. 0 in.
DOUGLAS DC-8	Monocoque elliptical-section fuselage. Close-spaced frames and stringers 75ST, skins 75 and 14ST6. Three-spar wing with roll-tapered 75ST skins.	Four integral tanks each wing, one in centre-section. Bag tanks in wing fillets. Capacity 14,654 I.G. (Srs. 10/20), 19,481 I.G. (Srs. 30/40/50). Four-point pressure refuelling at 1,200 U.S. g.p.m.	Four-wheel bogie main units with Cleveland oleos, inwards retracting with castoring rear trucks for taxiing. Twin-wheel steerable nosewheel. Bendix wheels and brakes. T: 20 ft. 10 in. B: 57 ft. 5 in. Tyre pressure 148–168 p.s.i.
FOKKER F.27	Semi-monocoque oval-section fuselage. Two-spar wing comprising centre-section, outer panels and tips, with Redux bonding. Principal materials 75ST6 and 24ST4.	Two integral tanks in wings. Capacity 795 I.G. Gravity refuelling (pressure optional) at 80 g.p.m.	Dowty main and steerable nose oleos. Dunlop or Goodyear twin wheels, tyres and pneumatic brakes and Maxarets. T: 23 ft. 7½ in. B: 28 ft. 8 in. Tyre pressure 80 p.s.i.
GRUMMAN GULFSTREAM	Semi-monocoque circular-section fuselage. Wing in two outer panels with centre-section carrying engine nacelles; main torsion box has integral machined skins.	Integral tanks in wing torsion box. Capacity 1,290 I.G. Water-methanol tanks outboard of main fuel tanks. Capacity 70 I.G. Gravity refuelling.	Bendix main wheel oleos, with twin Goodyear wheels, retract forwards into nacelles; steerable twin nosewheel retracts forwards. Westinghouse Decelostats. T: 24 ft. 2 in. B: 19 ft. 9 in.
HANDLEY PAGE HERALD	Stressed-skin compound-radius section fuselage. Three-spar wing c/s and two-spar outer wings with detachable tips. Spot-welding and sandwich construction throughout airframe.	Four bag tanks in centre-section and integral tank in each outer wing. Capacity 1,080 I.G. Gravity refuelling (pressure optional) at 120 g.p.m.	Twin-wheel Electro-Hydraulics nose and main units. Steerable nosewheel. Goodyear wheels, tyres and brakes. T: 22 ft. B: 25 ft. 10 in. (29 ft. 4 in. Srs. 200). Tyre pressure 58 p.s.i.
ILYUSHIN IL-18 MOSCOW	Circular-section monocoque fuselage. Three-spar main wing section, 72-ft. span, and two-spar extension planes. Fail-safe construction.	Integral tanks between spars in outer planes, 20 bag tanks in inner wing. Capacity 5,200 I.G. Four-point pressure refuelling.	Four-wheel bogie main units, forwards retracting into inboard nacelles, and forwards-retracting twin-wheel steerable nosewheel. Hydraulic brakes. T: 29 ft. 6 in. B: 41 ft. 11 in. Tyre pressure 113 p.s.i.
LOCKHEED ELECTRA	Semi-monocoque circular-section fuselage. Two-spar box-beam wing in two units and c/s integral with fuselage. Integrally stiffened wing panels are machined extrusions.	Two integral tanks between spars. Capacity 4,596 I.G. (5,429 I.G. optional). Single-point pressure refuelling at 350 U.S. g.p.m.	Forwards retracting main and nose gear, both incorporating dual wheels. Goodrich wheels and brakes. T: 31 ft. 2 in. B: 37 ft. Tyre pressure 114 p.s.i. at max. landing weight.
LOCKHEED JETSTAR	Circular-section semi-monocoque fuselage of fail-safe design using small 24ST skin panels. Torsion box wing in two halves attaching to fuselage frames.	Integral tank in each wing half. Capacity 1,395 I.G. External glove tanks on each wing, total capacity 832 I.G. Pressure refuelling at 200 U.S. g.p.m.	Main oleos with twin wheels retract sideways into centre-section; steerable nose oleo with twin wheels retracts forwards. T: 12 ft. 4 in. B: 20 ft. 8 in.
MAX HOLSTE SUPER BROUSSARD	Semi-monocoque fuselage of roughly rectangular cross-section with curved sides. Torsion box wing in two halves attached to separate centre section. Fabric covered control surfaces.	Six light-alloy tanks in wings; gravity refuelling. Capacity 396 I.G.	Semi-independent main oleo pneumatic shock absorbers retract backwards into fuselage-side housings: Oleo pneumatic self-stabilizing nosewheel. Hydraulic brakes. T: 9 ft. 10 in. B: 18 ft. Tyre pressure 54 p.s.i.
NAMCO YS II	Circular-section semi-monocoque fuselage. Straight-tapered torsion-box wing in two sections joining centre-section through fuselage. Fail-safe construction.	Integral tanks in wings outboard of nacelles. Capacity 1,005 I.G.; optional bag tanks inboard of nacelles, capacity 490 I.G. Water-methanol tank in port wing, capacity 105 I.G.	Forwards retracting main and nosewheel oleos with low pressure tyres. Brakes and anti-skid units. T: 28 ft. 3 in. B: 30 ft. 11 in.
POTEZ 840	Monocoque circular-section fuselage. Straight tapered single-spar fail-safe wing in two halves attached to fuselage centre-section.	Integral tanks in each wing. Capacity 350 I.G. Gravity refuelling.	Messier main wheel oleos retract sideways into wing. Nosewheel retracts forwards into fuselage.
SUD-AVIATION CARAVELLE	Circular-section monocoque fuselage. Torsion-box wing structure with three spars, built in two pieces joined on fuselage centre line.	Two integral tanks in each wing. Capacity 4,125 I.G. Two-point pressure refuelling at 500 g.p.m.	Hispano-Suiza oleos for four-wheel bogie main units, and steerable twin n/w. Dunlop Maxarets. Hispano wheels, tyres and brakes. T: 17 ft. B: 38 ft. 7 in. Tyre pressure 124 p.s.i.
SHORT BELFAST	Semi-monocoque fuselage of compound-radius section. Box-spar wing in two main units joined to centre-section integral with fuselage.	Integral tanks between spars. Capacity 10,090 I.G. Two-point pressure refuelling at 600 g.p.m.	Eight-wheel Electro-Hydraulics main bogies retract forwards into fuselage-side blisters. Twin-wheel nosewheel. T: 19 ft. 4 in. B: 48 ft. 11½ in. Tyre pressure 115 p.s.i.
VICKERS VANGUARD	Double-bubble monocoque fuselage. Torsion-box wing with three shear webs and integrally machined upper and lower skin-stringer panels.	Two integral tanks in each wing. Capacity 5,100 I.G. Single-point pressure refuelling at 600 g.p.m.	Vickers main and steerable nose oleos, all forwards retracting. Dunlop or Goodyear wheels, brakes and anti-skid. T: 30 ft. 3 in. B: 40 ft. 6½ in. Tyre pressure 105–123 p.s.i.
VICKERS VC10	Double-bubble monocoque fuselage. Torsion-box wing in five sections, with c/s built into lower half of fuselage. Four shear webs and integral-machined wing panels.	Three integral tanks in each wing and one in centre-section, between spars. Capacity 17,300 I.G. Two-point pressure refuelling at 1,000 g.p.m.	Four-wheel main bogies, inwards retracting; twin-wheel steerable nosewheel forwards retracting. Dunlop wheels, disc brakes and Maxarets. T: 21 ft. 3 in. B: 66 ft. Tyre pressure 115 p.s.i.

BINE TRANSPORT ENGINEERING DETAILS

	FLYING CONTROLS	FLAPS, AIR BRAKES	CABIN CONDITIONING	HYDRAULICS	ELECTRICS	
with twin unlop disc 6 in. B:	All manual. Three-section ailerons with spring and geared tabs. Four-part elevator with geared, spring and trim tabs. Rudders with spring and geared tabs. Smiths S.E.P.2 a/p.	Double-slotted flaps in two segments each side. No air brakes.	Three Godfrey engine-driven blowers. Godfrey cold-air unit. dP 5.5 p.s.i.	Duplicated 2,500–3,000 p.s.i. system powered by three pumps to operate u/c, nosewheel steering, brakes and flaps. Electric power pack for emergency use.	Four 6 kW. engine-driven generators for 28V. D.C.; two invertors for A.C. supply and three alternators for de-icing current.	Two ea for wi intakes
gs retract win nose- 9 in. B:	All manual, with set-back hinges and horn-balanced rudder. Gear tab on each aileron and trim tab on one. Gear trim tabs on both elevators. Spring and trim tabs on rudder.	Fowler-type in one piece each side, with additional trailing edge tab to increase drag in landing. Electrically operated. No air brakes.	Two Godfrey engine-driven blowers. dP 4.2 p.s.i.	2,500 p.s.i. system powered by two pumps for u/c, brakes, nosewheel steering and optional propeller brakes (plus manual emergency pump for u/c).	Primary 28V. D.C. system for two engine-driven generators, plus two alternators for 115V. A.C. and a third alternator for 200V. A.C. for engine and propeller de-icing.	Wing a energis
retracting eel; anti- 9 ft.	Aerodynamically balanced manual low-speed ailerons, separate high-speed ailerons and differential spoilers. Manual elevators, fully powered rudder. Electrically v.i. tailplane. Bendix PB–20D a/p.	Double-slotted trailing edge in two portions on each wing. Four (120/320/420) or eight (720) segments of l.e. flap. Inboard and outboard spoilers on upper surface of each wing, also acting as air brake up to 320 k. I.A.S.	Air-cycle or vapour-cycle system. Two or three turbocompressors powered by engine-bleed air. dP 8.6 p.s.i.	Utility and auxiliary 3,000 p.s.i. systems, engine and electric pump-powered for u/c, brakes, flaps, spoilers and nosewheel steering.	Four 30 kVA. three-phase Westinghouse alternators for 115–200V. 400-cycle A.C. Rectifiers for 28V. D.C., and 36 amp.-hr. battery.	Wing a air; de screen
t sideways nose oleo all units. anti-skid	Hydraulically powered ailerons (aerodynamically balanced for manual emergency), spoilers (differential to assist lateral control), rudder and elevators. "q" feel. Variable-incidence tailplane.	Triple-slotted t.e. flaps, retractable l.e. slats outboard and Krueger flaps inboard, covering whole span.	Engine-bleed air for dual cycle air-conditioning. dP 8.6 p.s.i.	Dual system from two engine-driven pumps, for u/c, n/w steer, brakes, flaps, flying controls and rear airstairs.	Primary A.C. from three engine-driven generators with D.C. through transformer-rectifiers. Electric operation of forward airstairs.	
ds retract- osewheel. T: 31 ft. s.i.	Fully manual, with servo operation. Spring-loading in aileron and rudder circuits and hydraulic artificial feel system for elevator. Ailerons "up" assisted by spoilers in upper surface up to 200 knots. Bendix PB–20H a/p.	Double-slotted Fowler-type flaps in two portions on each wing. No air brakes.	Two Godfrey engine-driven compressors. dP 6.55 p.s.i.	Two Vickers Inc. pumps power main 3,000 p.s.i. system for u/c, brakes, nosewheel steer, cargo door and swing-tail operation, with emergency compressed-air system for u/c and brakes.	Westinghouse 40 kVA. three-phase 400-cycle alternators with Sundstrand drive for 115V. A.C. plus variable frequency A.C. from Westinghouse 60 kVA. generators and 28V. D.C. through rectifiers.	Thermal over en dual he propell
n bogies, steerable Goodyear heels and rtional on ft. 11 in.	Fully manual inboard ailerons with servo tabs and differentially operated inner and outer spoilers. Manual rudder (880), power boost (880-M) and hydraulic-manual with "q" feel (990). Manual elevator with servo tabs. Hydraulic v.i. tailplane with electric and manual back-up. Bendix PB–20G or Sperry S.P. 30 a/p.	Double-slotted Fowler-type flaps in three pieces each side. Four-piece l.e. slats on each wing interconnected with flaps on 880-M and 990. Four upperwing spoilers ahead of flaps, and u/c as air brake up to max. speed.	Hamilton Standard Freon system. Two turbo-compressors driven by engine-bleed air. dP 8.3 p.s.i.	Four Vickers Inc. engine-driven pumps for dual 3,000 p.s.i. system for flaps, u/c, spoilers, v.i. tailplane, brakes and n/w steering; flaps and spoilers operate from either system.	Four 40 kVA. General Electric engine-driven generators provide 115/208V. 400-cycle A.C.; four G.E. transformer-rectifiers for 28V. D.C. and Nickel Cadmium 28V. battery.	Wing an electric fog rem
through tomotive p wheels, 0 in.	Two-section ailerons, inners only at high speeds. All-moving t/p, geared elevator. Triplicated hydraulic actuators close to all controls. Smiths-Kelvin/Sperry flight control system.	Double-slotted flaps in four sections, interconnected drooping l.e. Lift dumpers forward of inner flaps, spoilers ahead of outer flaps. U/c and reverse thrust used as air brakes.	D.H. air-conditioning system fed by engine-bleed air. Provision for APU for ground use. dP 8.25 p.s.i.	Three independent 3,000 p.s.i. systems powered by three Vickers-Sperry pumps, with independent stand-by, to operate flying controls, u/c, brakes, flaps, droop l.e., slats, air brakes and lift dumpers.	Three B.T.H. A.C. generators for 400-cycle three-phase 115/200V. A.C. and, through three rectifiers, 28V. D.C.	Airframe intakes, screen
Cleveland ring rear steerable brakes. pressure	Interconnected two-piece ailerons each side; outer portions operate through pre-loaded torque link from hydraulically boosted inners at low speeds only. Hydraulically boosted rudder. Manual elevator with aerodynamic tabs, and v.i. tailplane. Sperry S.P. 30 a/p.	Double-slotted flaps in four portions. Two fixed l.e. slots each side, inboard of pylons. Four upper wing spoilers linked with nose-wheel to destroy lift.	Four Douglas turbocompressors powered by engine-bleed air for identical duplicated system. Carrier Corp. freon vapour-cycle refrigeration. dP 8.77 p.s.i.	Main 3,000 p.s.i. system from two Vickers Inc. engine-driven pumps and electrically driven pumps for auxiliary system, for u/c, flaps, power controls, n/w steering and brakes; separate electrically powered system for spoilers.	Four 20 kVA. engine-driven Jack and Heintz generators for three-phase 115/200V. 400-cycle constant frequency A.C. and four G.E. 50-amp. transformer-rectifiers for 28V. D.C.	Wings, air; No removal
. Dunlop pneumatic ½ in. B:	Manual, aerodynamically balanced ailerons with trim, spring and servo tabs; manual aerodynamically balanced elevator and rudder, the latter with geared and trim tabs. Smiths S.E.P.2 a/p.	Single-slotted flaps in one piece each side, electrically actuated. No air brakes.	Two engine-driven Godfrey compressors. dP 4.16 p.s.i.	NO HYDRAULICS. Two independent 3,300 p.s.i. pneumatic systems with Dunlop engine-driven compressors for u/c, brakes and n/w steering.	24–28V. D.C. from two Bendix engine-mounted generators and secondary three-phase 115V. 400-cycle A.C. from two Bendix invertors. Jack and Heintz (D.C.) and Westinghouse (A.C.) accessories for U.S. models.	Wing an Electric spinner
Goodyear nacelles; forwards. ft. 2 in.	Manual, aerodynamically balanced ailerons, elevators and rudder. Spring tabs both ailerons; trim tabs port aileron and both elevators. Combined spring/trim tab on rudder; Sperry SP–20 or Collins AP–101E a/p.	Fowler flaps in one piece each side from fuselage to aileron. Main u/c as speed brake.	Pressurization by Godfrey engine-driven supercharger in starboard nacelle, with AiResearch APU stand-by. AiResearch bootstrap air cycle conditioning and emergency ram air ventilation.	Two N.Y. Air Brake engine-driven pumps for 1,500 p.s.i. system (Skydrol) for flaps, u/c, brakes, n/w steer, propeller brake, windscreen wipers and airstairs.	Two Jack and Heintz engine-driven generators for 28V. D.C. and two Leland 1,500 V.A. invertors; two Sonotone 24V. nickel-cadmium storage batteries.	B.F. Goo tail; wi
and main Goodyear 2 ft. B: 0). Tyre	Rod-, cable- and chain-operated. Spring-tabbed ailerons and rudder, spring and geared tabs on elevators.	Fowler-type flaps in one piece each side. No air brakes.	Two engine-driven compressors. dP 4.2 p.s.i.	3,000 p.s.i. system supplied by two Lockheed pumps, for u/c, flaps, n/w steering, brakes.	Two 28V. 6 kW. D.C. generators (one each engine). Four 24V. batteries for starting, general and emergency use.	Wing, fi exhaust windsc
ds retract- forwards- osewheel. 1 ft. 11 in.	Manual, rod-operated, aerodynamically balanced ailerons, elevators and rudder; trim tabs on elevator and rudder, spring tab on rudder only. Autopilot.	Single-slotted flaps in one piece on each wing. No air brakes.	Pressurization by engine-bleed air through heat exchangers. dP 7.1 p.s.i.	3,000 p.s.i. system with two NP–25 engine-driven pumps and two 2,100 p.s.i. stand-by nitrogen-charged accumulators for u/c, brakes, flaps, n/w steering and windscreen wipers.	Eight 12 kW. engine-driven generators for 24V. D.C., and four 8 kW. alternators and an invertor for single-phase A.C. and two invertors for 3-phase A.C.	Electro-t propell bleed a
gear, both ch wheels ft. Tyre eight.	Hydraulically boosted ailerons, elevators and rudder, with manual by-pass and manual trim. Bendix PB–20E a/p.	High-lift Fowler-type flaps in one piece each side.	AiResearch system. Two engine-driven compressors. Freon vapour-cycle and two independent air-cycle cooling systems. dP 6.5 p.s.i.	Two independent 3,000 p.s.i. systems with three Vickers Inc. electrically driven pumps for power controls, flaps, u/c, brakes, n/w steering.	Four General Electric engine-driven 60 kVA. generators for 120/208V. 400-cycle 3-phase A.C., and two Westinghouse rectifiers for 28V. D.C.; 24V. battery.	Airframe de-icing
sideways oleo with 2 ft. 4 in.	Hydraulically boosted ailerons and elevators. Manual, aerodynamically balanced rudder. Variable incidence elevator and trim tabs in ailerons and rudder. Lear L–102 a/p.	Flaps in two pieces each side. Full-span automatic leading edge slats. Speed brake under fuselage and provision for drag chute.	Engine-bleed air through heat exchangers. Two air-cycle refrigeration units. dP 8.9 p.s.i.	Independent 3,000 p.s.i. systems from engine-driven pumps (auxiliary 2,300 p.s.i. systems from electric pump) for flaps, speed brake, u/c, brakes, elevators and control boost.	Two 400-amp. starter-generators and two 12V. batteries for D.C.; two 1,500 V.A. 3-phase invertors for D.C.; one 250 V.A. and one 100 V.A. transistorized invertor.	Pneumat bleed a
tic shock fuselage- stabilizing ft. 10 in.	All manual system, cable operated. Aerodynamically balanced ailerons, elevators and rudder.	Slotted flaps in two sections each side. No air brakes.	Unpressurized cabin with air conditioning by individual ventilators and glass wool sound-proofing.	Hydraulic operation of flaps, undercarriage and brakes.	Two 6 kW. engine-driven generators and a 28V. 35 a.h. storage battery in the fuselage nose.	Goodric and ta propell
heel oleos and anti- 11 in.	Fully manual system, with tabs on all control surfaces. Space provision for autopilot.	Fowler-type flaps in two sections each side. No air brakes.	Four engine-driven superchargers including one stand-by to provide pressurization at dP of 4.16 p.s.i. Ground conditioning from one engine.	3,000 p.s.i. system for flaps, u/c, n/w steering, brakes, propeller brakes, windscreen wipers and ground cooling blower.	Two 12 kW. engine-driven generators and two 24 a.h. batteries for 28V. D.C. Two 25 kVA. and one 0.5 kVA. invertors and four 30 kVA. "frequency-wild" alternators.	Hot air heaters propell
sideways forwards	All manual system. Tabs on all surfaces. Lightweight autopilot fitted.	Double-slotted flaps in three sections each side. No air brakes.	Pressurized, dP 4.16 p.s.i.	—	Electric flap operation.	
ogie main Maxarets. T: 17 ft. 24 p.s.i.	Hydraulically powered two-piece ailerons, rudder and elevator, with artificial feel. Lear L–102 a/p.	Slotted flaps in four sections each side. Spoilers above and below each wing ahead of flaps on Caravelle VI R/VII/X.	AiResearch system. Two compressors driven by engine-bleed air. dP 8.05 p.s.i.	Twin 2,500 p.s.i. systems (each with electrically powered stand-by) for flying controls, u/c, wheel brakes, flaps, spoilers, nosewheel steering, airstairs and feel simulators.	Two Auxilec engine-driven 30V. D.C. generators provide 28.5V. D.C. and 115V. 400-cycle A.C. through two invertors. 26V. A.C. available also through transformer.	Wings, air.
n bogies blisters. 4 in. B: .i.	Manually operated full-servo tabs on all surfaces. Spring feel for ailerons and rudder; Hobson "q" feel unit for elevators.	Fowler-type flaps in one piece each side. Two-piece upper-wing spoilers.	Four Godfrey engine-driven blowers. De Havilland Freon vapour-cycle cooling. dP 6.55 p.s.i.	British Messier 4,000 p.s.i. system for u/c, brakes, n/w steer, flaps, control ground locks and "q" feel. APU for ground operation.	Eight 50 kVA. engine-driven alternators for 200V. A.C. "frequency-wild" power and 28V. D.C. through transformer-rectifiers. A.P.U.-driven alternator for ground operation.	Wings tail un elemen
oleos, all Goodyear 0 ft. 3 in. 23 p.s.i.	Manually operated through push-pull rods with aerodynamic balance and spring tabs. Collins AP–103 or Smiths S.E.P.2 a/p.	Constant-chord Fowler-type flaps in four sections per side. No air brakes.	Two Godfrey Roots-type engine-driven blowers. Cooling by air-cycle refrigeration. dP 6.5 p.s.i.	Duplicated 3,000 p.s.i. system powered by four engine-driven pumps for u/c, flaps, brakes, n/w steering, airstairs and propeller brakes.	Six Rotax variable frequency 50 kVA. alternators provide 208V. A.C. and, via four transformer/rectifiers, 28V. D.C. for main electrical demand.	Wings Nos. 1 unit, Sp tric cyc
etracting; forwards rakes and ft. Tyre	Fully powered, with sectionalized surfaces and individual actuators for each section operated by duplicated independent control systems. Artificial feel. Elliott-Bendix PB20 a/p.	Fowler-type flaps in five sections per side. Full span leading edge slats. Three spoilers above each wing.	Four Lysholm engine-driven compressors. Freon vapour-cycle conditioning and humidification system. Liquid oxygen emergency system. dP 9.0 p.s.i.	Two independent 3,000 p.s.i. systems for u/c, brakes, n/w steering, slats, flaps, spoilers and v.i. tailplane. Emergency ram-air turbine.	Plessey/Westinghouse electrical system with four 40 kVA. constant-speed engine-driven generators to give 115/200V. 400-cycle 3-phase A.C. Emergency ram-air turbo alternator. 28V. D.C. supply with split-source.	Wing, ta Ness gi

TURBINE TRANSPORT ENGINEERING DET

	STRUCTURE	FUEL SYSTEM	UNDERCARRIAGE	FLYING CONTROLS	FLAPS, AIR BRAKES	C
DSY	Semi-monocoque, open-ended fuselage. Two-spar mass boom wing in five sections. Twin tail booms.	Ten bag tanks between spars. Capacity 3,300 I.G. Two-point pressure refuelling at 300 g.p.m.	Dowty oleos, backwards retracting, with twin main and steerable nosewheels. Dunlop disc brakes and Maxarets. T: 32 ft. 6 in. B: 25 ft. 5 in. Tyre pressure 88 p.s.i.	All manual. Three-section ailerons with spring and geared tabs. Four-part elevator with geared, spring and trim tabs. Rudders with spring and geared tabs. Smiths S.E.P.2 a/p.	Double-slotted flaps in two segments each side. No air brakes.	Three cold-
.. ..	Circular-section fuselage. Two-spar wing in one piece each side, attaching to integral wing/fuselage centre-section. Principal materials L.65, L.72, L.73 and L.77 aluminium alloys.	One integral tank each wing. Capacity 1,100 I.G. Gravity refuelling (pressure optional).	Twin-wheel British Messier main legs retract forwards into nacelles. Steerable twin nosewheel folds forwards. T: 24 ft. 9 in. B: 20 ft. 1 in. Tyre pressure 40 p.s.i.	All manual, with set-back hinges and horn-balanced rudder. Gear tab on each aileron and trim tab on one. Gear trim tabs on both elevators. Spring and trim tabs on rudder.	Fowler-type in one piece each side, with additional trailing edge tab to increase drag in landing. Electrically operated. No air brakes.	Two p.s.i.
.. ..	Double-bubble semi-monocoque fuselage; close-spaced frames, stringers and skins of aluminium alloys. Two-spar wing in two main panels joined by fuselage-width centre-section; multi-panel tapered skins.	Three integral tanks in each wing and/or one in each root and bladder tank in centre-section. Capacity 11,280 I.G. (120); 19,607 I.G. (320/420); 9,780—13,400 I.G. (720). Four-point pressure refuelling at 1,500 U.S. g.p.m.	Four-wheel bogie main units, inwards retracting and twin-wheel steerable nosewheel; anti-skid units fitted. T: 22 ft. 1 in. B: 59 ft.	Aerodynamically balanced manual low-speed ailerons, separate high-speed ailerons and differential spoilers. Manual elevators, fully powered rudder. Electrically v.i. tailplane. Bendix PB–20D a/p.	Double-slotted trailing edge in two portions on each wing. Four (120/320/420) or eight (720) segments of l.e. flap. Inboard and outboard spoilers on upper surface of each wing, also acting as air brake up to 320 k. I.A.S.	Air-cy three bleed
.. ..	Semi-monocoque circular-section fuselage with Z-section frames and top-hat stiffeners. Two-spar wing assembled as one piece, through fuselage. Spars carry shear loads; skins and stringers carry banding loads.	Integral tanks in wing torsion box. Capacity 5,829 I.G. Pressure refuelling.	Loud Manufacturing main oleos retract sideways into fuselage; Menasco steerable nose oleo retracts forwards; twin wheels on all units. Nosewheel brake and main wheel anti-skid units. T: 18 ft. 9 in. B: 53 ft. 3 in.	Hydraulically powered ailerons (aerodynamically balanced for manual emergency), spoilers (differential to assist lateral control), rudder and elevators. "q" feel. Variable-incidence tailplane.	Triple-slotted t.e. flaps, retractable l.e. slats outboard and Krueger flaps inboard, covering whole span.	Engine dP 8.(
.. ..	Circular-section semi-monocoque fuselage with hinged tail. Two-spar wing in two main units joined at fuselage centre-line. Stiffened, stress-carrying upper and lower skins. Principally 2075–T and 2024–T.	Six-bay integral tanks in wings; capacity 8,520 I.G. Optional six-cell bag tank in centre-section; capacity 1,620 I.G. Pressure refuelling at 500 U.S. g.p.m.	Four-wheel bogie main units, backwards retracting, and steerable twin-wheel nosewheel. Hydraulic brakes. Bendix anti-skid. T: 31 ft. B: 49 ft. 11 in. Tyre pressure 160 p.s.i.	Fully manual, with servo operation. Spring-loading in aileron and rudder circuits and hydraulic artificial feel system for elevator. Ailerons "up" assisted by spoilers in upper surface up to 200 knots. Bendix PB–20H a/p.	Double-slotted Fowler–type flaps in two portions on each wing. No air brakes.	Two G 6.55 p
.. ..	Quasi-elliptical section fuselage with heavy-gauge 2024 alloy skin. Three-spar wing with built-up spars and machine-tapered skins; 2024–T4 lower skin ,7075 upper skin.	Two integral tanks in each wing give basic 880 capacity of 8,970 I.G.; centre-section tanks in 880-M to give capacity of 10,508 I.G.; shock-body tanks in 990 to give capacity of 13,049 I.G. Four-point pressure refuelling at 1,000 g.p.m.	Cleveland oleos for four-wheel main bogies, inwards retracting. Twin-wheel steerable nosewheel, forwards retracting. Goodyear (880) or Bendix (880-M, 990) wheels and brakes, Hydro-Aire anti-skid (proportional on 880-M, 990). T: 18 ft. 10½ in. B: 52 ft. 11 in. Tyre pressure 120–140 p.s.i.	Fully manual inboard ailerons with servo tabs and differentially operated inner and outer spoilers. Manual rudder (880), power boost (880-M) and hydraulic-manual with "q" feel (990). Manual elevator with servo tabs. Hydraulic v.i. tailplane with electric and manual back-up. Bendix PB–20G or Sperry S.P. 30 a/p.	Double-slotted Fowler-type flaps in three pieces each side. Four-piece l.e. slats on each wing interconnected with flaps on 880-M and 990. Four upperwing spoilers ahead of flaps, and u/c as air brake up to max. speed.	Hamilt compr 8.3 p.s
.. ..	Circular-section monocoque fuselage. Two-spar wing with third spar over centre-section and inner wings. Naturally aged Al-Cu alloys for skins and stringers.	Two-bay integral tank in each wing. Optional centre-section tank. Capacity 3,840 I.G.	Four-abreast main wheel units pivot through 90° and fold sideways. Offset Automotive Products n/w folds sideways. Dunlop wheels, tyres, brakes. T: 19 ft. 1 in. B: 44 ft. 0 in.	Two-section ailerons, inners only at high speeds. All-moving t/p, geared elevator. Triplicated hydraulic actuators close to all controls. Smiths-Kelvin/Sperry flight control system.	Double-slotted flaps in four sections, interconnected drooping l.e. Lift dumpers forward of inner flaps, spoilers ahead of outer flaps. U/c and reverse thrust used as air brakes.	D.H. a bleed use.
.. ..	Monocoque elliptical-section fuselage. Close-spaced frames and stringers 75ST, skins 75 and 14ST6. Three-spar wing with roll-tapered 75ST skins.	Four integral tanks each wing, one in centre-section. Bag tanks in wing fillets. Capacity 14,654 I.G. (Srs. 10/20), 19,481 I.G. (Srs. 30/40/50). Four-point pressure refuelling at 1,200 U.S. g.p.m.	Four-wheel bogie main units with Cleveland oleos, inwards retracting with castoring rear trucks for taxiing. Twin-wheel steerable nosewheel. Bendix wheels and brakes. T: 20 ft. 10 in. B: 57 ft. 5 in. Tyre pressure 148–168 p.s.i.	Interconnected two-piece ailerons each side; outer portions operate through pre-loaded torque link from hydraulically boosted inners at low speeds only. Hydraulically boosted rudder. Manual elevator with aerodynamic tabs, and v.i. tailplane. Sperry S.P. 30 a/p.	Double-slotted flaps in four portions. Two fixed l.e. slots each side, inboard of pylons. Four upper wing spoilers linked with nose-wheel to destroy lift.	Four D engine system refrige
.. ..	Semi-monocoque oval-section fuselage. Two-spar wing comprising centre-section, outer panels and tips, with Redux bonding. Principal materials 75ST6 and 24ST4.	Two integral tanks in wings. Capacity 795 I.G. Gravity refuelling (pressure optional) at 80 g.p.m.	Dowty main and steerable nose oleos. Dunlop or Goodyear twin wheels, tyres and pneumatic brakes and Maxarets. T: 23 ft. 7½ in. B: 28 ft. 8 in. Tyre pressure 80 p.s.i.	Manual, aerodynamically balanced ailerons with trim, spring and servo tabs; manual aerodynamically balanced elevator and rudder, the latter with geared and trim tabs. Smiths S.E.P.2 a/p.	Single-slotted flaps in one piece each side, electrically actuated. No air brakes.	Two dP 4.1
.. ..	Semi-monocoque circular-section fuselage. Wing in two outer panels with centre-section carrying engine nacelles; main torsion box has integral machined skins.	Integral tanks in wing torsion box. Capacity 1,290 I.G. Water-methanol tanks outboard of main fuel tanks. Capacity 70 I.G. Gravity refuelling.	Bendix main wheel oleos, with twin Goodyear wheels, retract forwards into nacelles; steerable twin nosewheel retracts forwards. Westinghouse Decelostats. T: 24 ft. 2 in. B: 19 ft. 9 in.	Manual, aerodynamically balanced ailerons, elevators and rudder. Spring tabs both ailerons; trim tabs port aileron and both elevators. Combined spring/trim tab on rudder; Sperry SP–20 or Collins AP–101E a/p.	Fowler flaps in one piece each side from fuselage to aileron. Main u/c as speed brake.	Pressur charge APU cycle ventila
.. ..	Stressed-skin compound-radius section fuselage. Three-spar wing c/s and two-spar outer wings with detachable tips. Spot-welding and sandwich construction throughout airframe.	Four bag tanks in centre-section and integral tank in each outer wing. Capacity 1,080 I.G. Gravity refuelling (pressure optional) at 120 g.p.m.	Twin-wheel Electro-Hydraulics nose and main units. Steerable nosewheel. Goodyear wheels, tyres and brakes. T: 22 ft. B: 25 ft. 10 in. (29 ft. 4 in. Srs. 200). Tyre pressure 58 p.s.i.	Rod-, cable- and chain-operated. Spring-tabbed ailerons and rudder, spring and geared tabs on elevators.	Fowler-type flaps in one piece each side. No air brakes.	Two en
.. ..	Circular-section monocoque fuselage. Three-spar main wing section, 72-ft. span, and two-spar extension planes. Fail-safe construction.	Integral tanks between spars in outer planes, 20 bag tanks in inner wing. Capacity 5,200 I.G. Four-point pressure refuelling.	Four-wheel bogie main units, forwards retracting into inboard nacelles, and forwards-retracting twin-wheel steerable nosewheel. Hydraulic brakes. T: 29 ft. 6 in. B: 41 ft. 11 in. Tyre pressure 113 p.s.i.	Manual, rod-operated, aerodynamically balanced ailerons, elevators and rudder; trim tabs on elevator and rudder, spring tab on rudder only. Autopilot.	Single-slotted flaps in one piece on each wing. No air brakes.	Pressur heat e
.. ..	Semi-monocoque circular-section fuselage. Two-spar box-beam wing in two units and c/s integral with fuselage. Integrally stiffened wing panels are machined extrusions.	Two integral tanks between spars. Capacity 4,596 I.G. (5,429 I.G. optional). Single-point pressure refuelling at 350 U.S. g.p.m.	Forwards retracting main and nose gear, both incorporating dual wheels. Goodrich wheels and brakes. T: 31 ft. 2 in. B: 37 ft. Tyre pressure 114 p.s.i. at max. landing weight.	Hydraulically boosted ailerons, elevators and rudder, with manual by-pass and manual trim. Bendix PB–20E a/p.	High-lift Fowler-type flaps in one piece each side.	AiResea presso indepe 6.5 p.s
.. ..	Circular-section semi-monocoque fuselage of fail-safe design using small 24ST skin panels. Torsion box wing in two halves attaching to fuselage frames.	Integral tank in each wing half. Capacity 1,395 I.G. External glove tanks on each wing, total capacity 832 I.G. Pressure refuelling at 200 U.S. g.p.m.	Main oleos with twin wheels retract sideways into centre-section; steerable nose oleo with twin wheels retracts forwards. T: 12 ft. 4 in. B: 20 ft. 8 in.	Hydraulically boosted ailerons and elevators. Manual, aerodynamically balanced rudder. Variable incidence elevator and trim tabs in ailerons and rudder. Lear L–102 a/p.	Flaps in two pieces each side. Full-span automatic leading edge slats. Speed brake under fuselage and provision for drag chute.	Engine air-cyc
.. ..	Semi-monocoque fuselage of roughly rectangular cross-section with curved sides. Torsion box wing in two halves attached to separate centre section. Fabric covered control surfaces.	Six light-alloy tanks in wings; gravity refuelling. Capacity 396 I.G.	Semi-independent main oleo pneumatic shock absorbers retract backwards into fuselage-side housings: Oleo pneumatic self-stabilizing nosewheel. Hydraulic brakes. T: 9 ft. 10 in. B: 18 ft. Tyre pressure 54 p.s.i.	All manual system, cable operated. Aerodynamically balanced ailerons, elevators and rudder.	Slotted flaps in two sections each side. No air brakes.	Unpress individ proofi
.. ..	Circular-section semi-monocoque fuselage. Straight-tapered torsion-box wing in two sections joining centre-section through fuselage. Fail-safe construction.	Integral tanks in wings outboard of nacelles. Capacity 1,005 I.G.; optional bag tanks inboard of nacelles, capacity 490 I.G. Water-methanol tank in port wing, capacity 105 I.G.	Forwards retracting main and nosewheel oleos with low pressure tyres. Brakes and anti-skid units. T: 28 ft. 3 in. B: 30 ft. 11 in.	Fully manual system, with tabs on all control surfaces. Space provision for autopilot.	Fowler-type flaps in two sections each side. No air brakes.	Four e one st of 4.16 engine
.. ..	Monocoque circular-section fuselage. Straight tapered single-spar fail-safe wing in two halves attached to fuselage centre-section.	Integral tanks in each wing. Capacity 350 I.G. Gravity refuelling.	Messier main wheel oleos retract sideways into wing. Nosewheel retracts forwards into fuselage.	All manual system. Tabs on all surfaces. Light-weight autopilot fitted.	Double-slotted flaps in three sections each side. No air brakes.	Pressur
.. ..	Circular-section monocoque fuselage. Torsion-box wing structure with three spars, built in two pieces joined on fuselage centre line.	Two integral tanks in each wing. Capacity 4,125 I.G. Two-point pressure refuelling at 500 g.p.m.	Hispano-Suiza oleos for four-wheel bogie main units, and steerable twin n/w. Dunlop Maxarets. Hispano wheels, tyres and brakes. T: 17 ft. B: 38 ft. 7 in. Tyre pressure 124 p.s.i.	Hydraulically powered two-piece ailerons, rudder and elevator, with artificial feel. Lear L–102 a/p.	Slotted flaps in four sections each side. Spoilers above and below each wing ahead of flaps on Caravelle VI R/VII/X.	AiResea by eng
.. ..	Semi-monocoque fuselage of compound-radius section. Box-spar wing in two main units joined to centre-section integral with fuselage.	Integral tanks between spars. Capacity 10,090 I.G. Two-point pressure refuelling at 600 g.p.m.	Eight-wheel Electro-Hydraulics main bogies retract forwards into fuselage-side blisters. Twin-wheel nosewheel. T: 19 ft. 4 in. B: 48 ft. 11½ in. Tyre pressure 115 p.s.i.	Manually operated full-servo tabs on all surfaces. Spring feel for ailerons and rudder; Hobson "q" feel unit for elevators.	Fowler-type flaps in one piece each side. Two-piece upper-wing spoilers.	Four C Havilla p.s.i.
.. ..	Double-bubble monocoque fuselage. Torsion-box wing with three shear webs and integrally machined upper and lower skin-stringer panels.	Two integral tanks in each wing. Capacity 5,100 I.G. Single-point pressure refuelling at 600 g.p.m.	Vickers main and steerable nose oleos, all forwards retracting. Dunlop or Goodyear wheels, brakes and anti-skid. T: 30 ft. 3 in. B: 40 ft. 6½ in. Tyre pressure 105–123 p.s.i.	Manually operated through push-pull rods with aerodynamic balance and spring tabs. Collins AP–103 or Smiths S.E.P.2 a/p.	Constant-chord Fowler-type flaps in four sections per side. No air brakes.	Two Go Coolin p.s.i.
.. ..	Double-bubble monocoque fuselage. Torsion-box wing in five sections, with c/s built into lower half of fuselage. Four shear webs and integral-machined wing panels.	Three integral tanks in each wing and one in centre-section, between spars. Capacity 17,300 I.G. Two-point pressure refuelling at 1,000 g.p.m.	Four-wheel main bogies, inwards retracting; twin-wheel steerable nosewheel forwards retracting. Dunlop wheels, disc brakes and Maxarets. T: 21 ft. 3 in. B: 66 ft. Tyre pressure 115 p.s.i.	Fully powered, with sectionalized surfaces and individual actuators for each section operated by duplicated independent control systems. Artificial feel. Elliott-Bendix PB20 a/p.	Fowler-type flaps in five sections per side. Full span leading edge slats. Three spoilers above each wing.	Four Freon fication system

DETAILS

CABIN CONDITIONING	HYDRAULICS	ELECTRICS	DE-ICING
Three Godfrey engine-driven blowers. Godfrey cold-air unit. dP 5.5 p.s.i.	Duplicated 2,500–3,000 p.s.i. system powered by three pumps to operate u/c, nosewheel steering, brakes and flaps. Electric power pack for emergency use.	Four 6 kW. engine-driven generators for 28V. D.C.; two invertors for A.C. supply and three alternators for de-icing current.	Two exhaust heat exchangers provide hot air for wings; electric heaters for tail unit, engine intakes and propeller. Nesa glass windscreen.
Two Godfrey engine-driven blowers. dP 4.2 p.s.i.	2,500 p.s.i. system powered by two pumps for u/c, brakes, nosewheel steering and optional propeller brakes (plus manual emergency pump for u/c).	Primary 28V. D.C. system for two engine-driven generators, plus two alternators for 115V. A.C. and a third alternator for 200V. A.C. for engine and propeller de-icing.	Wing and tail by chordwise rubber boots energized by engine-bleed air.
Air-cycle or vapour-cycle system. Two or three turbocompressors powered by engine-bleed air. dP 8.6 p.s.i.	Utility and auxiliary 3,000 p.s.i. systems, engine and electric pump-powered for u/c, brakes, flaps, spoilers and nosewheel steering.	Four 30 kVA. three-phase Westinghouse alternators for 115–200V. 400-cycle A.C. Rectifiers for 28V. D.C., and 36 amp.-hr. battery.	Wing and intakes anti-icing by engine-bleed air; de-icing mats on tail. Nesa glass windscreen.
Engine-bleed air for dual cycle air-conditioning. dP 8.6 p.s.i.	Dual system from two engine-driven pumps, for u/c, n/w steer, brakes, flaps, flying controls and rear airstairs.	Primary A.C. from three engine-driven generators with D.C. through transformer-rectifiers. Electric operation of forward airstairs.	—
Two Godfrey engine-driven compressors. dP 6.55 p.s.i.	Two Vickers Inc. pumps power main 3,000 p.s.i. system for u/c, brakes, nosewheel steer, cargo door and swing-tail operation, with emergency compressed-air system for u/c and brakes.	Westinghouse 40 kVA. three-phase 400-cycle alternators with Sundstrand drive for 115V. A.C. plus variable frequency A.C. from Westinghouse 60 kVA. generators and 28V. D.C. through rectifiers.	Thermal anti-icing of wing by ram-air passed over engine tail-pipes; tail unit by hot air from dual heater system; electric de-icing for intakes, propellers, screen and elevator horn balances.
Hamilton Standard Freon system. Two turbo-compressors driven by engine-bleed air. dP 8.3 p.s.i.	Four Vickers Inc. engine-driven pumps for dual 3,000 p.s.i. system for flaps, u/c, spoilers, v.i. tailplane, brakes and n/w steering; flaps and spoilers operate from either system.	Four 40 kVA. General Electric engine-driven generators provide 115/208V. 400-cycle A.C.; four G.E. transformer-rectifiers for 28V. D.C. and Nickel Cadmium 28V. battery.	Wing and intakes anti-iced by engine-bleed air; electric tail unit de-icing; Nesa glass screen fog removal and air-blast rain removal.
D.H. air-conditioning system fed by engine-bleed air. Provision for APU for ground use. dP 8.25 p.s.i.	Three independent 3,000 p.s.i. systems powered by three Vickers-Sperry pumps, with independent stand-by, to operate flying controls, u/c, brakes, flaps, droop l.e., slats, air brakes and lift dumpers.	Three B.T.H. A.C. generators for 400-cycle three-phase 115/200V. A.C. and, through three rectifiers, 28V. D.C.	Airframe de-icing, including engine and air intakes, by engine-bleed air. Electric film screen de-icing.
Four Douglas turbocompressors powered by engine-bleed air for identical duplicated system. Carrier Corp. freon vapour-cycle refrigeration. dP 8.77 p.s.i.	Main 3,000 p.s.i. system from two Vickers Inc. engine-driven pumps and electrically driven pumps for auxiliary system, for u/c, flaps, power controls, n/w steering and brakes; separate electrically powered system for spoilers.	Four 20 kVA. engine-driven Jack and Heintz generators for three-phase 115/200V. 400-cycle constant frequency A.C. and four G.E. 50-amp. transformer-rectifiers for 28V. D.C.	Wings, tail unit and intakes by engine-bleed air; Nesa glass screen and air-blast rain removal.
Two engine-driven Godfrey compressors. dP 4.16 p.s.i.	NO HYDRAULICS. Two independent 3,300 p.s.i. pneumatic systems with Dunlop engine-driven compressors for u/c, brakes and n/w steering.	24–28V. D.C. from two Bendix engine-mounted generators and secondary three-phase 115V. 400-cycle A.C. from two Bendix invertors. Jack and Heintz (D.C.) and Westinghouse (A.C.) accessories for U.S. models.	Wing and tail unit by Goodrich rubber boots. Electrical de-icing of intakes, propellers, spinners and windshield.
Pressurization by Godfrey engine-driven supercharger in starboard nacelle, with AiResearch APU stand-by. AiResearch bootstrap air cycle conditioning and emergency ram air ventilation.	Two N.Y. Air Brake engine-driven pumps for 1,500 p.s.i. system (Skydrol) for flaps, u/c, brakes, n/w steer, propeller brake, windscreen wipers and airstairs.	Two Jack and Heintz engine-driven generators for 28V. D.C. and two Leland 1,500 V.A. invertors; two Sonotone 24V. nickel-cadmium storage batteries.	B.F. Goodrich pneumatic boots for wings and tail; windscreen by electric elements.
Two engine-driven compressors. dP 4.2 p.s.i.	3,000 p.s.i. system supplied by two Lockheed pumps, for u/c, flaps, n/w steering, brakes.	Two 28V. 6 kW. D.C. generators (one each engine). Four 24V. batteries for starting, general and emergency use.	Wing, fin and tailplane by hot air from engine exhaust heat exchanger. Electrical system for windscreen.
Pressurization by engine-bleed air through heat exchangers. dP 7.1 p.s.i.	3,000 p.s.i. system with two NP-25 engine-driven pumps and two 2,100 p.s.i. stand-by nitrogen-charged accumulators for u/c, brakes, flaps, n/w steering and windscreen wipers.	Eight 12 kW. engine-driven generators for 24V. D.C., and four 8 kW. alternators and an invertor for single-phase A.C. and two invertors for 3-phase A.C.	Electro-thermal de-icing of wing, fin, tailplane, propellers, spinners and windscreen. Engine-bleed air for intake de-icing.
AiResearch system. Two engine-driven compressors. Freon vapour-cycle and two independent air-cycle cooling systems. dP 6.5 p.s.i.	Two independent 3,000 p.s.i. systems with three Vickers Inc. electrically driven pumps for power controls, flaps, u/c, brakes, n/w steering.	Four General Electric engine-driven 60 kVA. generators for 120/208V. 400-cycle 3-phase A.C., and two Westinghouse rectifiers for 28V. D.C.; 24V. battery.	Airframe de-icing by engine-bleed air. Electric de-icing for windscreen and propellers.
Engine-bleed air through heat exchangers. Two air-cycle refrigeration units. dP 8.9 p.s.i.	Independent 3,000 p.s.i. systems from engine-driven pumps (auxiliary 2,300 p.s.i. systems from electric pump) for flaps, speed brake, u/c, brakes, elevators and control boost.	Two 400-amp. starter-generators and two 12V. batteries for D.C.; two 1,500 V.A. 3-phase invertors for D.C.; one 250 V.A. and one 100 V.A. transistorized invertor.	Pneumatic boots for wing and tail. Engine-bleed air for intakes. Hot air for windscreen.
Unpressurized cabin with air conditioning by individual ventilators and glass wool sound-proofing.	Hydraulic operation of flaps, undercarriage and brakes.	Two 6 kW. engine-driven generators and a 28V. 35 a.h. storage battery in the fuselage nose.	Goodrich-Kleber Colombes pneumatic wing and tail de-icing. Liquid protection of propellers.
Four engine-driven superchargers including one stand-by to provide pressurization at dP of 4.16 p.s.i. Ground conditioning from one engine.	3,000 p.s.i. system for flaps, u/c, n/w steering, brakes, propeller brakes, windscreen wipers and ground cooling blower.	Two 12 kW. engine-driven generators and two 24 a.h. batteries for 28V. D.C. Two 25 kVA. and one 0.5 kVA. invertors and four 30 kVA. "frequency-wild" alternators.	Hot air wing and tail de-icing using combustion heaters. Electric de-icing of windscreen, propellers and intakes.
Pressurized, dP 4.16 p.s.i.	—	Electric flap operation.	—
AiResearch system. Two compressors driven by engine-bleed air. dP 8.05 p.s.i.	Twin 2,500 p.s.i. systems (each with electrically powered stand-by) for flying controls, u/c, wheel brakes, flaps, spoilers, nosewheel steering, airstairs and feel simulators.	Two Auxilec engine-driven 30V. D.C. generators provide 28.5V. D.C. and 115V. 400-cycle A.C. through two invertors. 26V. A.C. available also through transformer.	Wings, tail unit and intakes by engine-bleed air.
Four Godfrey engine-driven blowers. De Havilland Freon vapour-cycle cooling. dP 6.55 p.s.i.	British Messier 4,000 p.s.i. system for u/c, brakes, n/w steer, flaps, control ground locks and "q" feel. APU for ground operation.	Eight 50 kVA. engine-driven alternators for 200V. A.C. "frequency-wild" power and 28V. D.C. through transformer-rectifiers. A.P.U.-driven alternator for ground operation.	Wings by hot air from engine heat-exchanger; tail unit, spinners and intakes by electric elements.
Two Godfrey Roots-type engine-driven blowers. Cooling by air-cycle refrigeration. dP 6.5 p.s.i.	Duplicated 3,000 p.s.i. system powered by four engine-driven pumps for u/c, flaps, brakes, n/w steering, airstairs and propeller brakes.	Six Rotax variable frequency 50 kVA. alternators provide 208V. A.C. and, via four transformer/rectifiers, 28V. D.C. for main electrical demand.	Wings by engine heat exchangers. Alternator on Nos. 1 or 4 engine provides current for tail unit, Spraymats and Triplex windscreen. Electric cyclic for propellers, spinners and engines.
Four Lysholm engine-driven compressors. Freon vapour-cycle conditioning and humidification system. Liquid oxygen emergency system. dP 9.0 p.s.i.	Two independent 3,000 p.s.i. systems for u/c, brakes, n/w steering, slats, flaps, spoilers and v.i. tailplane. Emergency ram-air turbine.	Plessey/Westinghouse electrical system with four 40 kVA. constant-speed engine-driven generators to give 115/200V. 400-cycle 3-phase A.C. Emergency ram-air turbo alternator. 28V. D.C. supply with split source.	Wing, tail and powerplant by engine-bleed air. Nesa glass windscreen.

WEIGHTS AND PERFORMANCE—TURBOJET

AIRCRAFT	POWER PLANT			WEIGHTS						WING LOADINGS		Best Cost (or Typical) Cruise				Speed Cruise	
	No.	Type	T.O. Power (each)	Basic op.	Total Fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Take-off weight	Landing weight	Speed	Alt.	Weight	Con-sumption	Speed	Alt.
			lb. s.t.	lb.	lb.	lb.	lb.	lb.	lb.	lb./sq. ft.	lb./sq. ft.	knots	ft.	lb.	l.g./h.	knots	ft.
Boeing 707–120	4	P. & W. JT3C–6	13,500	113,369	116,566	37,381	247,000	175,000	165,000	101.5	71.9	—	—	200,000	2,000	508	25,00
Boeing 707–120B	4	P. & W. JT3D–1	17,000	120,734	116,566	37,381	257,000	185,000	170,000	106.0	76.0	—	—	200,000	2,775	540	25,00
Boeing 707–320	4	P. & W. JT4A–9	16,800	132,627	159,560	40,053	312,000	207,000	190,000	107.0	71.7	—	—	200,000	3,250	521	25,00
Boeing 707–320B	4	P. & W. JT3D–3	18,000	135,088	159,560	54,912	315,000	207,000	190,000	107.5	70.5	—	—	—	—	518	25,00
Boeing 707–420	4	R.R. Conway 508	17,500	—	159,560	40,053	312,000	207,000	190,000	107.0	71.7	—	—	200,000	2,690	524	25,00
Boeing 720	4	P. & W. JT3C–7	12,000	105,040	79,227	34,264	216,000	175,000	142,000	83.0	71.9	—	—	180,000	2,075	521	25,00
Boeing 720B	4	P. & W. JT3D–1	17,000	109,580	99,026	34,264	221,000	175,000	147,000	90.8	71.9	—	—	200,000	2,775	540	25,00
Boeing 727	3	P. & W. JT8D–1	14,000	81,500	46,900	24,000	142,000	131,000	109,000	86.0	79.0	515	25,000	120,000	—	520	25,00
Convair 880 (Domestic)	4	G.E. CJ805–3	11,200	88,615	72,160	23,150	184,500	132,800	117,000	92.25	66.40	484	35,000	150,000	1,275	534	22,50
Convair 880–M (Overwater)	4	G.E. CJ805–3B	11,650	93,000	84,554	24,165	192,700	155,000	121,500	96.35	77.50	484	35,000	—	—	534	22,50
Convair 990 (Overwater)	4	G.E. CJ805–23	16,100	120,560	105,000	26,440	244,200	180,000	154,000	108.5	80.0	495	35,000	200,000	1,455	556	21,50
D.H. Comet 4	4	R.R. Avon 524	10,500	74,900	71,220	20,300	162,000	120,000	99,000	76.4	56.6	448	28,500	135,000	1,140	—	—
D.H. Comet 4B	4	R.R. Avon 525B	10,500	77,200	62,400	24,600	158,000	120,000	102,500	76.7	58.2	462	23,500	135,000	1,430	—	—
D.H. Comet 4C	4	R.R. Avon 525B	10,500	77,700	71,200	24,600	162,000	120,000	102,500	76.4	56.6	442	33,000	135,000	1,090	—	—
D.H. Trident I	3	R.R. Spey (R.B.163–1)	10,400	63,200	31,720	22,000	105,000	100,000	85,500	77.4	73.6	508	32,000	100,000	914	526	25,00
Douglas DC–8 Srs. 10	4	P. & W. JT3C–6	13,500	120,999	117,900	34,030	273,000	193,000	—	98.6	69.6	471	30,000	220,000	—	—	—
Douglas DC–8 Srs. 20	4	P. & W. JT4A–3	15,800	123,757	117,900	34,030	276,000	193,000	—	99.6	69.6	503	30,000	220,000	—	—	—
Douglas DC–8 Srs. 30	4	P. & W. JT4A–11	17,500	135,378	156,760	34,360	315,000	207,000	—	109.9	72.1	514	30,000	220,000	—	—	—
Douglas DC–8 Srs. 40	4	R.R. Conway	17,500	134,062	156,760	36,175	315,000	207,000	—	109.9	72.1	509	30,000	220,000	—	—	—
Douglas DC–8 Srs. 50	4	P. & W. JT3D–3	18,000	132,325	156,760	34,360	315,000	207,000	—	109.9	72.1	503	30,000	220,000	—	—	—
Lockheed 1329 JetStar	4	P. & W. JT–12A	3,000	20,030	17,621	2,420	40,100	28,700	22,450	74.0	53.0	430	40,000	31,000	342	474	25,00
Sud Caravelle III	2	R.R. Avon 527	11,400	59,686	33,500	18,300	101,413	96,584	78,264	64.23	61.16	414	35,000	82,000	680	432	25,00
Sud Caravelle VI	2	R.R. Avon 531	12,200	61,225	33,500	18,141	105,820	100,780	79,366	67.02	63.82	428	35,000	87,000	775	450	25,00
Sud Caravelle VIR	2	R.R. Avon 533R	12,600	63,856	33,500	17,715	110,232	104,980	81,571	69.81	66.49	423	35,000	91,000	780	456	25,00
Sud Caravelle VII	2	G.E. CJ–805–23C	16,100	66,490	33,500	19,490*	114,640	109,180	85,980	72.60	69.14	424	35,000	95,000	710	456	25,00
Sud Caravelle X	2	P. & W. JT8D–1	14,000	63,820	38,140	17,750*	113,540	108,130	81,570	71.90	68.48	428	35,000	93,000	695	452	25,00
Tu–104A	2	Mikulin AM–3	19,180	—	60,000	29,430	166,450	141,100	—	91.2	—	—	—	—	—	513	—
VEB 152	4	Pirna O14–A1	7,275	64,800	28,935	20,100	112,436	89,340	—	75.7	60.2	432	—	—	—	—	—
Vickers VC10	4	R.R. Conway 540	20,250	138,500	138,000	38,000*	299,000	199,000	178,000	106.9	70.5	480	42,000	240,000	1,675	510	30,00

WEIGHTS AND PERFORMANCE—TURBOPRO

AIRCRAFT	POWER PLANT			WEIGHTS						WING LOADINGS		Best Cost (or Typical) Cruise				Speed Cruise	
	No.	Type	T.O. Power (each)	Basic op.	Total Fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Take-off weight	Landing weight	Speed	Alt.	Weight	Con-sumption	Speed	Alt.
			e.h.p.	lb.	lb.	lb.	lb.	lb.	lb.	lb./sq. ft.	lb./sq. ft.	knots	ft.	lb.	l.g./h.	knots	ft.
Allison-Convair	2	Allison 501-D13D	3,750	33,050	11,792	13,950	53,200	50,670	47,000	57.8	55.1	305	20,000	48,000	261	305	20,00
A.W. 650 Argosy	4	R.R. Dart 526	2,100	48,500	26,400	28,000	88,000	80,000	76,000	60.0	55.5	266	20,500	79,000	350	244	15,00
Antonov An–10A	4	Ivchenko AI–20	4,015	—	22,600	32,000	121,500	—	—	88.0	—	325	26,000	—	—	—	—
Avro 748 Srs. 1	2	R.R. Dart 514	1,740	19,444	8,800	9,666	33,000	33,000	29,110	41.5	41.5	230	20,000	31,000	156	—	—
Avro 748 Srs. 2	2	R.R. Dart 531	2,105	20,344	8,800	9,666	36,000	35,500	30,010	45.25	44.65	252	25,000	34,000	156	—	—
Breguet 941C	4	Turbomeca Turmo IIID	1,250	26,345	11,580	12,346	44,092	39,683	—	49.6	45.0	216	—	—	—	—	—
Bristol Britannia 320	4	Bristol Proteus 765	4,450	93,631	68,376	30,000	185,000	137,000	128,000	89.2	67.0	349	21,000	150,000	765	360	23,00
Canadair CL–44D (Cargo)	4	R.R. Tyne 515	5,730	90,000	81,500	65,000*	205,000	165,000	155,000	99.0	79.6	343	21,000	175,000	730	343	20,00
Canadair CL–44D (Pass.)	4	R.R. Tyne 515	5,730	102,000	81,500	37,000	205,000	165,000	139,000	99.0	79.6	350	20,000	165,000	715	352	17,00
Canadair 540	2	Napier Eland 504A	3,500	34,061	13,614	12,939*	53,200	50,670	47,000	57.9	55.1	278	14,000	48,000	309	278	14,00
Fairchild F–27	2	R.R. Dart 511-7E	1,720	23,002	9,000	10,194	39,000	37,500	35,200	51.7	50.0	236	20,000	35,000	156	—	—
Fairchild F–27A	2	R.R. Dart 528-7E	2,105	23,526	9,000	10,194	42,000	37,500	35,700	55.7	50.0	262	20,000	38,000	181	—	—
Grumman Gulfstream	2	R.R. Dart 529	2,190	21,900	10,460	4,270	35,100	33,600	26,170	57.2	54.8	302	25,000	27,500	168	302	25,00
H.P.R.7 Herald 100	2	R.R. Dart 527	2,105	24,420	8,640	10,290	40,000	39,500	36,000	45.1	44.6	229	23,000	38,000	166	237	15,00
H.P.R.7 Herald 200	2	R.R. Dart 527	2,105	24,958	8,640	12,040	40,000	39,500	37,000	45.1	44.6	229	23,000	38,000	166	237	15,00
Ilyushin Il–18B	4	Ivchenko AI–20	4,015	61,730	42,770	30,865	135,600	—	—	89.1	—	330	26,250	—	—	350	—
Lockheed Electra	4	Allison 501–D13	3,750	60,800	43,700	23,000	116,000	95,650	86,000	89.2	73.5	353	20,000	85,000	553	353	20,00
M.H. 260 S. Broussard	2	Bastan IV	986	11,940	3,650	8,560	21,600	20,720	20,050	36.4	35.0	187	10,000	21,380	90	210	10,00
Namco YS–11	2	R.R. Dart 542	3,060	31,966	12,220	12,125*	50,265	48,047	44,092	49.4	47.2	250	20,000	47,600	210	261	15,00
Potez 840	4	Astazou II	554	9,450	2,730	5,280	16,760	15,860	14,480	44.0	42.0	270	18,000	16,700	70	285	15,00
Short Belfast	4	R.R. Tyne R.Ty. 12	5,730	111,000	80,720	85,000	218,000	205,000	196,000	88.5	83.0	—	—	170,000	—	325	20,00
Sipa Presence	2	Astazou II	554	6,953	2,645	3,530	10,736	10,736	8,091	30.3	30.3	173	20,000	10,736	35	224	20,00
Tupolev Tu–114	4	Kuznetsov NK–12M	*10,000*	—	*134,000*	*55,100*	*396,800*	*275,600*	—	*120.3*	—	*400*	*36,000*	—	—	*460*	—
Vickers Viscount 700D	4	R.R. Dart 510	1,740	38,358	15,736	11,800	64,500	57,500	50,168	67.0	59.7	272	18,000	57,000	335	276	12,00
Vickers Viscount 810	4	R.R. Dart 525	1,990	43,000	15,200	14,500	72,500	64,000	57,500	75.4	66.4	309	18,000	60,000	400	317	12,00
Vickers Vanguard II	4	R.R. Tyne 512	5,545	85,500	41,040	37,000	146,500	130,500	122,500	96.0	88.3	358	20,000	135,000	710	367	15,00

WEIGHTS AND PERFORMANCE—PISTON ENG

AIRCRAFT	POWER PLANT			WEIGHTS						WING LOADINGS		Best Cost (or Typical) Cruise				Speed Cruise	
	No.	Type	T.O. Power (each)	Basic op.	Total Fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Take-off weight	Landing weight	Speed	Alt.	Weight	Con-sumption	Speed	Alt.
			h.p.	lb.	lb.	lb.	lb.	lb.	lb.	lb./sq. ft.	lb./sq. ft.	knots	ft.	lb.	l.g./h.	knots	ft
Aero Commander 680F	2	Lycoming IGSO–540–B1A	380	4,830	1,340	—	8,000	—	—	31.37	—	208	10,000	—	38	217	10,00
Aviation Traders Carvair	4	P. & W. R–2000–7M2	1,450	41,365	14,800	17,635	73,800	64,170	59,000	50.5	43.9	180	10,000	65,000	175	—	—
Beech G18S	2	P. & W. R–985–AN14B	450	6,260	1,900	2,200	9,700	—	—	26.9	—	—	—	—	—	186	10,00
D.H. 104 Dove 8	2	D.H. Gipsy Queen 70 Mk. 3	400	6,580	1,545	1,899	8,950	8,500	—	26.4	—	162	8,000	8,500	276	182	8,00
D.H. 114 Heron 2	4	D.H. Gipsy Queen 30 Mk. 2	250	8,996	2,965	3,460	13,500	13,150	12,740	27.1	26.4	159	8,000	12,500	42	166	3,00
D.H. C.3 Otter	1	P. & W. R–1340	600	4,368	1,282	3,220	8,000	—	—	21.3	—	111	5,000	—	—	121	—
D.H. C.4 Caribou	2	P. & W. R–2000–7M2	1,450	18,260	5,040	7,700	26,000	26,000	26,000	28.5	28.5	158	7,500	26,000	89	—	—
Piaggio P.166	2	Lycoming GSO–480–B1C6	340	5,560	1,335	1,830	8,115	8,115	—	28.4	28.4	168	12,500	8,115	—	195	9,50
Scottish Twin Pioneer 3	2	Alvis Leonides 531/8B	600	10,200	1,780	4,000	14,600	14,600	—	21.8	21.8	114	5,000	—	37	—	—
Short Skyvan	2	Continental GTS10–520	390	6,030	1,080	3,000	9,300	9,300	9,030	25.0	25.0	140	5,000	9,300	30	155	5,00

Approach speed is 1.3 Vso. Field lengths are based on the following requirements: A, B.C.A.R.; B, SR422B or appropriate CAR; C, ICAO; D, to and from 50 ft.; E, ground run; F, $V_1 = V_R$. Dat

RANSPORT AIRCRAFT SPECIFICATIONS

RBOJETS

PERFORMANCE

ed Cruise		Range Cruise		Approach speed	Ref.	Field length required			Landing I.S.A. s.l.	Range (take off to landing) no reserves						
						Take off				With max. fuel				With max. payload		
d	Alt.	Speed	Alt.			I.S.A. s.l.	I.S.A.+ 15°C. s.l.	I.S.A. 5,000 ft.		Range	Payload	Speed	Alt.	Range	Speed	Alt.
s	ft.	knots	ft.	knots		ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.	n. mi.	knots	ft.
	25,000	456	40,000	139	B	10,200	10,750	—	5,980	3,260	—	457	36,000	2,895	—	—
	25,000	470	40,000	136	B	8,800	11,000	13,000	5,950	6,000	19,000	460	40,000	4,100	—	—
	25,000	457	40,000	138	B	10,200	12,000	14,400	7,200	5,900	17,930	453	38,400	4,000	—	—
	25,000	457	40,000	138	B	9,600	9,800	13,000	6,400	—	—	—	—	—	—	—
	25,000	454	40,000	138	B	10,700	12,800	14,700	7,200	6,040	19,630	453	39,000	4,090	—	—
	25,000	465	40,000	126	B	7,400	8,300	9,800	5,750	3,700	18,270	465	37,500	2,760	—	—
	25,000	470	40,000	134	B	6,400	7,400	8,400	5,750	4,550	20,600	469	37,500	3,650	—	—
	25,000	450	40,000	110	B	5,250	6,000	7,600	4,980	3,000	14,000	445	35,000	—	—	—
	22,500	450	35,000	140	B	8,050	8,950	12,400	6,150	3,470	23,150	435	35,000	3,470	435	35,000
	22,500	—	—	—	B	8,750	9,850	—	5,930	4,050	15,846	439	35,000	3,560	458	35,000
	21,500	460	35,000	131	B	9,100	10,400	—	5,540	4,730	19,440	450	35 000	4,340	450	35,000
	—	—	—	124	A	6,750	7,500	9,300	6,630	3,920	16,400	405	37,000	3,640	—	—
	—	—	—	128	A	6,600	7,450	9,300	6,660	3,300	19,100	405	37,000	2,920	—	—
	—	—	—	126	A	6,750	7,500	9,300	6,630	3,890	13,800	405	37,000	3,140	—	—
	25,000	461	35,000	134	A	5,800	6,700	8,100	6,270	2,350	12,000	461	35,000	1,530	461	35,000
	—	—	—	128.5	B	9,380	—	—	6,400	3,734	—	—	—	—	—	—
	—	—	—	128.5	B	8,240	—	—	6,400	4,162	—	—	—	—	—	—
	—	—	—	132.5	B	9,650	—	—	6,800	5,183	—	—	—	—	—	—
	—	—	—	132.5	B	9,650	—	—	6,800	5,627	—	—	—	—	—	—
	—	—	—	132.5	B	10,380	—	—	6,550	6,157	—	—	—	—	—	—
	25,000	430	40,000	126	B	7,600	8,650	8,700	5,100	2,650	1,640	430	38,000	2,575	430	38,000
	25,000	396	35,000	123	B	6,100	7,000	9,100	5,900	2,315	8,430	400	35,000	1,565	390	35,000
	25,000	417	35,000	126	B	6,450	7,200	9,000	6,395	2,135	11,385	413	35,000	1,670	406	35,000
	25,000	411	35,000	128	B	6,650	7,400	9,400	5,415	2,085	13,195	409	35,000	1,780	403	35,000
	25,000	394	35,000	130	B	6,400	7,000	8,600	5,140	2,290	15,000	411	35,000	1,950	407	35,000
	25,000	414	35,000	129	B	6,650	7,330	9,000	5,470	2,655	11,820	416	35,000	2,210	411	35,000
	—	432	—	144	D	5,413	—	—	5,052	2,266	17,637	—	—	—	—	—
	—	—	—	—	D	4,570	—	—	2,345	1,600	13,980	—	—	1,250	—	—
	30,000	460	42,000	122.5	B	7,400	8,650	9,500	6,450	5,600	24,500	460	40,000	4,800	460	40,000

BOPROPS

PERFORMANCE

eed Cruise		Range Cruise		Approach speed	Ref.	Field length required			Landing I.S.A. s.l.	Range (take off to landing) no reserves						
						Take off				With max. fuel				With max. payload		
d	Alt.	Speed	Alt.			I.S.A. s.l.	I.S.A.+ 15°C. s.l.	I.S.A. 5,000 ft.		Range	Payload	Speed	Alt.	Range	Speed	Alt.
s	ft.	knots	ft.	knots		ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.	n. mi.	knots	ft.
	20,000	265	23,000	101	B	4,175	5,000	5,570	4,175	1,650	8,358	300	20,000	910	295	20,000
	15,000	288	25,000	118	A	4,900	5,200	6,350	5,200	2,050	13,100	228	20,000	750	200	10,000
	—	—	—	—	E	2,300	—	—	1,640	2,200	18,600	—	—	1,400	—	—
	—	—	—	92	A	3,500	3,750	4,750	2,190	1,650	4,436	234	20,000	580	—	—
	—	—	—	94	A	3,510	3,780	4,630	2,325	1,830	6,581	257	25,000	1,050	—	—
	—	—	—	84	B	975	—	—	1,180	1,320	4,000	216	—	270	—	—
	23,000	310	25,000	115	A	8,000	9,600	11,700	6,000	4,500	22,993	310	28,000	3,100	349	21,000
	20,000	331	25,000	132	B	6,800	7,870	—	5,980	5,700	34,250	343	25,000	2,540	330	23,500
	17,000	331	25,000	132	B	6,800	7,870	—	5,980	5,700	22,250	343	25,000	3,745	331	25,000
	14,000	225	20,000	130	B	4,550	5,250	6,175	4,020	1,680	5,675	278	20,000	774	278	20,000
	—	—	—	88	C	5,720	6,200	—	3,160	1,120	6,850	235	20,000	550	235	20,000
	—	—	—	90	C	5,600	6,100	—	3,160	1,100	9,150	262	20,000	960	262	20,000
	25,000	244	25,000	111.1	B	4,370	4,680	5,610	2,680	2,448	2,740	250	25,000	2,008	253	25,000
	15,000	229	23,000	90	A	4,480	4,910	5,250	3,765	1,500	6,770	229	23,000	760	229	23,000
	15,000	229	23,000	90	A	4,480	4,910	5,250	3,765	1,500	6,290	229	23,000	370	229	23,000
	—	—	—	130	D	3,780	—	—	3,800	3,020	—	—	26,250	1,350	—	—
	20,000	330	25,000	121	B	5,100	6,700	7,800	4,650	3,300	11,500	345	20,000	2,360	340	20,000
	10,000	—	—	85	B	3,900	—	—	3,715	766	6,200	187	10,000	202	187	10,000
	15,000	213	20,000	94	B	2,890	3,080	3,810	3,790	1,680	5,400	250	20,000	710	250	20,000
	15,000	215	18,000	97	B	2,200	2,500	3,300	1,900	1,152	15,400	200	20,000	1,050	200	20,000
	20,000	300	28,000	127	B	6,900	7,500	9,500	5,000	5,550	26,280	304	28,000	1,150	290	20,000
	20,000	—	—	82	D	1,755	2,325	2,390	1,720	1,350	1,080	210	20,000	162	167	10,000
	—	—	—	—	—	9,350	—	—	8,695	5,200†	—	—	—	—	—	—
	12,000	262	25,000	115	B	5,290	5,850	7,200	3,970	1,740	10,680	269	21,000	1,550	—	—
	12,000	298	25,000	121.5	B	5,930	6,480	7,950	4,450	1,530	14,300	290	24,000	1,500	290	24,000
	15,000	356	25,000	131.5	B	6,550	7,950	9,000	6,400	2,720	20,500	356	25,000	1,590	350	25,000

N ENGINED

PERFORMANCE

eed Cruise		Range Cruise		Approach speed	Ref.	Field length required			Landing I.S.A. s.l.	Range (take off to landing) no reserves						
						Take off				With max. fuel				With max. payload		
d	Alt.	Speed	Alt.			I.S.A. s.l.	I.S.A.+ 15°C. s.l.	I.S.A. 5,000 ft.		Range	Payload	Speed	Alt.	Range	Speed	Alt.
s	ft.	knots	ft.	knots		ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.	n. mi.	knots	ft.
	10,000	174	10,000	85	D	2,170	—	—	1,900	1,020	1,700	208	10,000	—	—	—
	—	—	—	93	B	5,300	5,950	7,050	2,800	3,000	10,000	177	10,000	2,000	177	10,000
	10,000	152	10,000	94	D	1,980	—	—	1,850	1,475	1,532	153	10,000	958	153	10,000
	8,000	150	8,000	84	D	2,270	—	—	1,920	1,175	—	162	8,000	323	—	8,000
	3,000	—	—	81	D	2,425	—	—	2,065	1,350	2,100	159	8,000	365	—	—
	—	—	—	59	D	1,310	—	—	975	755	2,140	121	5,000	—	—	—
	—	—	—	72	F	2,640	2,940	3,670	1,540	1,100	3,000	158	7,500	—	—	—
	9,500	145	13,500	84	B	2,200	—	—	1,540	1,040	1,067	152	12,000	250	155	6,000
	—	—	—	70	D	1,150	—	—	1,150	662	2,500	114	5,000	75	—	—
	5,000	105	10,000	75	A	1,900	2,000	2,250	2,170	800	2,200	105	10,000	200	140	5,000

Data in italic are provisional. * Weight limit. † With typical airline reserves.

DIMENSIONS

AIRCRAFT	Span	Length O.A.	Height O.A.	Gross wing area	Wing sweep-back	Interna	
						Length	Max. width
TURBOJET	ft. in.	ft. in.	ft. in.	sq. ft.	deg.	ft. in.	in.
Boeing 707–120 ..	130 10	144 6	42 0	2,433	35	104 10	139
Boeing 707–320/420 ..	142 5	152 11	41 8	2,892	35	111 6	139
Boeing 707–320B ..	145 8½	152 11	42 5½	2,942	35	111 6	139
Boeing 720	130 10	136 2	41 6½	2,433	35	96 6	139
Boeing 727	108 7	135 5	34 0	1,650	32	72 8	139
Convair 880/880M ..	120 0	129 4	36 4	2,000	35	89 3	128
Convair 990	120 0	134 9	39 6	2,250	35	98 9	128
D.H. Comet 4B ..	107 10	118 0	29 6	2,059	20	78 3	116
D.H. Comet 4C ..	114 9	118 0	29 6	2,121	20	78 3	116
D.H. Trident 1 ..	89 10	114 9	27 0	1,358	35	66 6	135.5
Douglas DC–8 ..	142 5	150 6	42 4	2,771	30	103 0	140
Lockheed JetStar ..	53 8	60 5½	20 6	542.5	30	28 2	69
Sud Caravelle III, VI, X	112 6	105 0	28 7	1,579	20	72 0	118.5
Sud Caravelle VII ..	112 6	108 0	28 7	1,579	20	75 0	118.5
Tupolev Tu–104 ..	113 4	127 6	*39 4½*	*1,825*	36	—	126
Vickers VC10 ..	140 0	158 10	39 1½	2,800	32.5	91 4	138
TURBOPROP							
Allison-Convair ..	105 4	81 6	29 2	920	Nil	43 1	113
A.W. 650 Argosy ..	115 0	86 9	27 0	1,458	Nil	46 8	120
Antonov An–10A ..	124 8	121 4	32 1	1,293	—	—	—
Avro 748	95 0	67 0	24 10	795	Nil	46 6	96.5
Breguet 941C ..	76 1	74 8½	30 8½	887	Nil	39 1½	96
Bristol Britannia 320 ..	142 3½	124 3	37 4½	2,075	7	86 3	139
Canadair CL–44D ..	142 3½	136 8	38 7	2,075	7	98 1	137
Canadair 540 ..	105 4	79 2	28 2	920	4.33	54 10	107
Fokker F–27	95 2	75 9	27 11	754	Nil	47 6	100
Grumman Gulfstream ..	78 4	64 6	22 9	615	Nil	33 0	88
H.P.R.7 Herald 100 ..	94 4½	71 11	24 0	886	Nil	38 4	104
H.P.R.7 Herald 200 ..	94 4½	75 5	24 0	886	Nil	—	104
Ilyushin Il–18B ..	122 8½	117 9	33 4	1,507	Nil	*85 0*	127
Lockheed Electra ..	99 0	104 8	32 10½	1,300	Nil	76 5	128
M.H.260 S. Broussard ..	71 8	58 1	21 0	592	Nil	21 4	86
Namco YS–11	105 0	86 3	30 0	1,020	Nil	44 1	106
Potez 840	63 8	51 3	18 3	377	Nil	23 0	71
Short Belfast ..	158 9½	136 5	47 0	2,466	7.05	84 6	184
Sipa Presence ..	57 1	45 7	15 1	355	Nil	21 0	84
Transall C.160 ..	131 3	102 0	38 6	1,722	Nil	42 8	124
Tupolev Tu–114 ..	177 2	*154 10*	*38 8½*	*3,350*	*35*	*154 2*	148
Vickers Viscount 700 ..	93 8½	81 10	26 9	963	Nil	45 0	119
Vickers Viscount 810 ..	93 8½	85 8	26 9	963	Nil	54 0	117
Vickers Vanguard ..	118 0	122 10½	34 11	1,529	Nil	90 0	128.8
PISTON-ENGINED							
Aero Commander 680F	49 6	35 1½	14 6	255	Nil	10 7½	52
Aviation Traders Carvair	117 6	102 7	30 0	1,462	Nil	80 2	116
Beech G18S	49 8	35 2½	9 8	361	Nil	10 5	52
D.H.104 Dove 8 ..	57 0	39 6	13 4	335	Nil	12 3	54
D.H.114 Heron 2 ..	71 6	48 6	15 7	499	Nil	23 0	54
D.H. C.3 Otter ..	58 0	41 10	13 0	375	Nil	12 8	62
D.H. C.4 Caribou ..	96 0	72 7	31 9	912	Nil	28 9	87
Piaggio P.166 ..	46 9	38 1	16 5	286	6	11 8½	62
Scottish Twin Pioneer 3	76 6	45 3	18 0	670	Nil	22 8	72
Short Skyvan ..	64 1	38 11	13 10	373	Nil	16 0	78
HELICOPTER	‡	‡		‡			
Sikorsky S.61L ..	62 0	54 9	15 4	3,019	—	31 11	78
Sud Frelon	49 2½	48 10½	15 5	1,894	—	22 11½	74.75
Vertol 107–II ..	50 0	44 7	16 10	1,995	—	24 2	79
Westland B.192C ..	48 11	57 2	17 4	1,880	—	24 0	68'
Westland Rotodyne 2	109 0*	69 5	27 3	9,340	Nil	52 9	116.5
Westland Wessex 2 ..	56 0	65 10	15 11	2,460	—	15 6	60

[1] Excludes toilet and galley. [2] Unfurnished. [3] Wing span 75 ft. 0 in. * Gross. ‡ Rotor diameter, length without r

WEIGHTS AND PERFORMANCE—MULTI-ENGINE TURB

	VERTOL 107–II†	SIKORSKY S.61L	W
WEIGHTS (for 100 ft./min. climb, s.l., with one engine inoperative)*			
Operating weight empty .. .. (lb.)	10,425	9,270	
Max. internal fuel .. .. (lb.)	—	2,835	
Max. payload .. .. (lb.)	8,000	8,900	
Max. take-off weight .. .. (lb.)	18,450	18,700	
Max. landing weight .. .. (lb.)	18,450	18,700	
Disc loading (max. t.-o. wt.) .. .. .. (lb./sq. ft.)	4.62	6.2	
PERFORMANCE (I.S.A., sea level)			
Best economical cruising speed .. .. .. (knots)	135	118	
at altitude at mean weight .. .. .. (ft./lb.)	1,000/–	0/17,500	2,
at power, h.p., with consumption, Imp. gal./hr.	—	1,400/142	
Initial climb, vertical .. .. (ft./min.)	1,240	600	
Initial climb, inclined .. .. (ft./min.)	1,700	1,600	
Best climb with one engine out .. .. .. (ft./min.)	—	300	
Hovering ceiling, out of ground effect .. .. .. (ft.)	—	5,000	
Hovering ceiling, in ground effect .. .. .. (ft.)	7,800	7,000	
Service ceiling .. .. (ft.)	13,700	9,500	
Range (no reserves, max. fuel) at speed (naut. mi./knots)	250/–	270/118	2
at altitude with payload .. .. .. (ft./lb.)	0/6,000	0/–	
Power plant	2 × CT58–110	2 × CT58–110	2
Max. t.-o. power .. .. (h.p./r.p.m.)	1,250/19,500	1,250/19,500	
Max. contingency rating .. .. (h.p./r.p.m.)	—	1,230/19,500	

* Westland 192C data are based on a 320 ft./min. climb with one engine inoperative and the other on inter
data, not necessarily uniform with remainder of tabulation. ‡ Using max. contingency power.

TRANSPORT AIRCRAFT SPECIFICATIONS

WEIGHTS AND PERFORMANCE—TURBOJETS

ER PLANT		WEIGHTS						WING LOADINGS		PERFORMANCE																		
										Best Cost (or Typical) Cruise				Speed Cruise		Range Cruise				Field length required					Range (take off to lan			
ype	T.O. Power (each)	Basic op.	Total Fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Take-off weight	Landing weight	Speed	Alt.	Weight	Con-sumption	Speed	Alt.	Speed	Alt.	Approach speed	Ref.	Take off			Landing I.S.A. s.l.	With max. fuel				
																				I.S.A. s.l.	I.S.A. + 15°C. s.l.	I.S.A. 5,000 ft.		Range	Payload	Speed	Alt.
	lb. s.c.	lb.	lb.	lb.	lb.	lb.	lb.	lb./sq. ft.	lb./sq. ft.	knots	ft.	lb.	l.g./h.	knots	ft.	knots	ft.	knots		ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.
C-6 ..	13,500	113,369	116,566	37,381	247,000	175,000	165,000	101.5	71.9	—	—	200,000	2,000	508	25,000	456	40,000	139	B	10,200	10,750	—	5,980	3,260	—	457	36,000
D-1 ..	17,000	120,734	116,566	37,381	257,000	185,000	170,000	106.0	76.0	—	—	200,000	2,775	540	25,000	470	40,000	136	B	8,800	11,000	13,000	5,950	6,000	19,000	460	40,000
A-9 ..	16,800	132,627	159,560	40,053	312,000	207,000	190,000	107.0	71.7	—	—	200,000	3,250	521	25,000	457	40,000	138	B	10,200	12,000	14,400	7,200	5,900	17,930	453	38,400
D-3 ..	18,000	135,088	159,560	54,912	315,000	207,000	190,000	107.5	70.5	—	—	—	—	518	25,000	457	40,000	138	B	9,600	9,800	13,000	6,400	—	—	—	—
y 508 ..	17,500	—	159,560	40,053	312,000	207,000	190,000	107.0	71.7	—	—	200,000	2,690	524	25,000	454	40,000	138	B	10,700	12,800	14,700	7,200	6,040	19,630	453	39,000
C-7 ..	12,000	105,040	79,227	34,264	216,000	175,000	142,000	83.0	71.9	—	—	180,000	2,075	521	25,000	465	40,000	126	B	7,400	8,300	9,800	5,750	3,700	18,270	465	37,500
D-1 ..	17,000	109,580	99,026	34,264	221,000	175,000	147,000	90.8	71.9	—	—	200,000	2,775	540	25,000	470	40,000	134	B	6,400	7,400	8,400	5,750	4,550	20,600	469	37,500
D-1 ..	14,000	81,500	46,900	24,000	142,000	131,000	109,000	86.0	79.0	515	25,000	120,000	—	520	25,000	450	40,000	110	B	5,250	6,000	7,600	4,980	3,000	14,000	445	35,000
3 ..	11,200	98,615	72,160	23,150	184,500	132,800	117,000	92.25	66.40	484	35,000	150,000	1,275	534	22,500	450	35,000	140	B	8,050	8,950	12,400	6,150	3,470	23,150	435	35,600
3B ..	11,650	93,000	84,554	24,165	192,700	155,000	121,500	96.35	77.50	484	35,000	—	—	534	22,500	—	—	—	B	8,750	9,850	—	5,930	4,050	15,846	439	35,000
23 ..	16,100	120,560	105,000	26,440	244,200	180,000	154,000	108.5	80.0	495	35,000	200,000	1,455	556	21,500	460	35,000	131	B	9,100	10,400	—	5,540	4,730	19,440	450	35 000
24 ..	10,500	74,900	71,220	20,300	162,000	120,000	99,000	76.4	56.6	448	28,500	135,000	1,140	—	—	—	—	124	A	6,750	7,500	9,300	6,630	3,920	16,400	405	37,000
25B ..	10,500	77,200	62,400	24,600	158,000	120,000	102,500	76.7	58.2	462	23,500	135,000	1,430	—	—	—	—	128	A	6,600	7,450	9,300	6,660	3,300	19,100	405	37,000
25B ..	10,500	77,700	71,200	24,600	162,000	120,000	102,500	76.4	56.6	442	33,000	135,000	1,090	—	—	—	—	126	A	6,750	7,500	9,300	6,630	3,890	13,800	405	37,000
.B.163-1) ..	10,400	63,200	31,720	22,000	105,000	100,000	85,500	77.4	73.6	508	32,000	100,000	914	526	25,000	461	35,000	134	A	5,800	6,700	8,100	6,270	2,350	12,000	461	35,000
C-6 ..	13,500	120,999	117,900	34,030	273,000	193,000	—	98.6	69.6	471	30,000	220,000	—	—	—	—	—	128.5	B	9,380	—	—	6,400	3,734	—	—	—
A-3 ..	15,800	123,757	117,900	34,030	276,000	193,000	—	99.6	69.6	503	30,000	220,000	—	—	—	—	—	128.5	B	8,240	—	—	6,400	4,162	—	—	—
A-11 ..	17,500	135,378	156,760	34,360	315,000	207,000	—	109.9	72.1	514	30,000	220,000	—	—	—	—	—	132.5	B	9,650	—	—	6,800	5,183	—	—	—
y ..	17,500	134,062	156,760	36,175	315,000	207,000	—	109.9	72.1	509	30,000	220,000	—	—	—	—	—	132.5	B	9,650	—	—	6,800	5,627	—	—	—
D-3 ..	18,000	132,325	156,760	34,360	315,000	207,000	—	109.9	72.1	503	30,000	220,000	—	—	—	—	—	132.5	B	10,380	—	—	6,550	6,157	—	—	—
12A ..	3,000	20,030	17,621	2,420	40,100	28,700	22,450	74.0	53.0	430	40,000	31,000	342	474	25,000	430	40,000	126	B	7,600	8,650	8,700	5,100	2,650	1,640	430	38,000
27 ..	11,400	59,686	33,500	18,300	101,413	96,584	78,264	64.23	61.16	414	35,000	82,000	680	432	25,000	396	35,000	123	B	6,100	7,000	9,100	5,900	2,315	8,430	400	35,000
31 ..	12,200	61,225	33,500	18,141	105,820	100,780	79,366	67.02	63.82	428	35,000	87,000	775	450	25,000	417	35,000	126	B	6,450	7,200	9,000	6,395	2,135	11,385	413	35,000
33R ..	12,600	63,856	33,500	17,715	110,232	104,980	81,571	69.81	66.49	423	35,000	91,000	780	456	25,000	411	35,000	128	B	6,650	7,400	9,400	5,415	2,085	13,195	409	35,000
-23C ..	16,100	66,490	33,500	19,490*	114,640	109,180	85,980	72.60	69.14	424	35,000	95,000	710	456	25,000	394	35,000	130	B	6,400	7,000	8,600	5,140	2,290	15,000	411	35,000
8D-1 ..	14,000	63,820	38,140	17,750*	113,540	108,130	81,570	71.90	68.48	428	35,000	93,000	695	452	25,000	414	35,000	129	B	6,650	7,330	9,000	5,470	2,655	11,820	416	35,000
-3 ..	19,180	—	60,000	29,430	166,450	141,100	—	91.2	—	—	—	—	—	513	—	432	—	144	D	5,413	—	—	5,052	2,266	17,637	—	—
A1 ..	7,275	64,800	28,935	20,100	112,436	89,340	—	75.7	60.2	432	—	—	—	—	—	—	—	—	D	4,570	—	—	2,345	1,600	13,980	—	—
y 540 ..	20,250	138,500	138,000	38,000*	299,000	199,000	178,000	106.9	70.5	480	42,000	240,000	1,675	510	30,000	460	42,000	122.5	B	7,400	8,650	9,500	6,450	5,600	24,500	460	40,000

WEIGHTS AND PERFORMANCE—TURBOPROPS

ER PLANT		WEIGHTS						WING LOADINGS		PERFORMANCE																		
										Best Cost (or Typical) Cruise				Speed Cruise		Range Cruise				Field length required					Range (take off to la			
ype	T.O. Power (each)	Basic op.	Total Fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Take-off weight	Landing weight	Speed	Alt.	Weight	Con-sumption	Speed	Alt.	Speed	Alt.	Approach speed	Ref.	Take off			Landing I.S.A. s.l.	With max. fuel				
																				I.S.A. s.l.	I.S.A. + 15°C. s.l.	I.S.A. 5,000 ft.		Range	Payload	Speed	Alt.
	e.h.p.	lb.	lb.	lb.	lb.	lb.	lb.	lb./sq. ft.	lb./sq. ft.	knots	ft.	lb.	l.g./h.	knots	ft.	knots	ft.	knots		ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.
D13D ..	3,750	33,050	11,792	13,950	53,200	50,670	47,000	57.8	55.1	305	20,000	48,000	261	305	20,000	265	23,000	101	B	4,175	5,000	5,570	4,175	1,650	8,358	300	20,000
26 ..	2,100	48,500	26,400	28,000	88,000	80,000	76,000	60.0	55.5	266	20,500	79,000	350	244	15,000	288	25,000	118	A	4,900	5,200	6,350	5,200	2,050	13,100	228	20,000
1–20 ..	4,015	—	22,600	32,000	121,500	—	—	88.0	—	325	26,000	—	—	—	—	—	—	—	E	2,300	—	—	1,640	2,200	18,600	—	—
14 ..	1,740	19,444	8,800	9,666	33,000	33,000	29,110	41.5	41.5	230	20,000	31,000	156	—	—	—	—	92	A	3,500	3,750	4,750	2,190	1,650	4,436	234	20,000
31 ..	2,105	20,344	8,800	9,666	36,000	35,500	30,010	45.25	44.65	252	25,000	34,000	156	—	—	—	—	94	A	3,510	3,780	4,630	2,325	1,830	6,581	257	25,000
Turmo IIID ..	1,250	26,345	11,580	12,346	44,092	39,683	—	49.6	45.0	216	—	—	—	—	—	—	—	84	B	975	—	—	1,180	1,320	4,000	216	—
eus 765 ..	4,450	93,631	68,376	30,000	185,000	137,000	128,000	89.2	67.0	349	21,000	150,000	765	360	23,000	310	25,000	115	A	8,000	9,600	11,700	6,000	4,500	22,993	310	28,000
15 ..	5,730	90,000	81,500	65,000*	205,000	165,000	155,000	99.0	79.6	343	21,000	175,000	730	343	20,000	331	25,000	132	B	6,800	7,870	—	5,980	5,700	34,250	343	25,000
15 ..	5,730	102,000	81,500	37,000	205,000	165,000	139,000	99.0	79.6	350	20,000	165,000	715	352	17,000	331	25,000	132	B	6,800	7,870	—	5,980	5,700	22,250	343	25,000
H 504A ..	3,500	34,061	13,614	12,939*	53,200	50,670	47,000	57.9	55.1	278	14,000	48,000	309	278	14,000	225	20,000	130	B	4,550	5,250	6,175	4,020	1,680	5,675	278	20,000
11-7E ..	1,720	23,002	9,000	10,194	39,000	37,500	35,200	51.7	50.0	236	20,000	35,000	156	—	—	—	—	88	C	5,720	6,200	—	3,160	1,120	6,850	235	20,000
28-7E ..	2,105	23,526	9,000	10,194	42,000	37,500	35,700	55.7	50.0	262	20,000	38,000	181	—	—	—	—	90	C	5,600	6,100	—	3,160	1,100	9,150	262	20,000
9 ..	2,190	21,900	10,460	4,270	35,100	33,600	26,170	57.2	54.8	302	25,000	27,500	168	302	25,000	244	25,000	111.1	B	4,370	4,680	5,610	2,680	2,448	2,740	250	25,000
27 ..	2,105	24,420	8,640	10,290	40,000	39,500	36,000	45.1	44.6	229	23,000	38,000	166	237	15,000	229	23,000	90	A	4,480	4,910	5,250	3,765	1,500	6,770	229	23,000
27 ..	2,105	24,958	8,640	12,040	40,000	39,500	37,000	45.1	44.6	229	23,000	38,000	166	237	15,000	229	23,000	90	A	4,480	4,910	5,250	3,765	1,500	6,290	229	23,000
-20 ..	4,015	61,730	42,770	30,865	135,600	—	—	89.1	—	330	26,250	—	—	350	—	—	—	130	D	3,780	—	—	3,800	3,020	—	—	26,250
D13 ..	3,750	60,800	43,700	23,000	116,000	95,650	86,000	89.2	73.5	353	20,000	85,000	553	353	20,000	330	25,000	121	B	5,100	6,700	7,800	4,650	3,300	11,500	345	20,000
—	986	11,940	3,650	8,560	21,600	20,720	20,050	36.4	35.0	187	10,000	21,380	90	210	10,000	—	—	85	B	3,900	—	—	3,715	766	6,200	187	10,000
42 ..	3,060	31,966	12,220	12,125*	50,265	48,047	44,092	49.4	47.2	250	20,000	47,600	210	261	15,000	213	20,000	94	B	2,890	3,080	3,810	3,790	1,680	5,400	250	20,000
Ty. 12 ..	554	9,450	2,730	5,280	16,760	15,860	14,480	44.0	42.0	270	18,000	16,700	70	285	15,000	215	18,000	97	B	2,200	2,500	3,300	1,900	1,152	15,400	200	20,000
	5,730	111,000	80,720	85,000	218,000	205,000	196,000	88.5	83.0	—	—	170,000	—	325	20,000	300	28,000	127	B	6,900	7,500	9,500	5,000	5,550	26,280	304	28,000
M ..	554	6,953	2,645	3,530	10,736	10,736	8,091	30.3	30.3	173	20,000	10,736	35	224	20,000	—	—	82	D	1,755	2,325	2,390	1,720	1,350	1,080	210	20,000
	10,000	—	*134,000*	*55,100*	*396,800*	*275,600*	—	*120.3*	—	*400*	*36,000*	—	—	*460*	—	—	—	—	—	9,350	—	—	8,695	5,200†	—	—	—
0	1,740	38,358	15,736	11,800	64,500	57,500	50,168	67.0	59.7	272	18,000	57,000	335	276	12,000	262	25,000	115	B	5,290	5,850	7,200	3,970	1,740	10,680	269	21,000
25 ..	1,990	43,000	15,200	14,500	72,500	64,000	57,500	75.4	66.4	309	18,000	60,000	400	317	12,000	298	25,000	121.5	B	5,930	6,480	7,950	4,450	1,530	14,300	290	24,000
2 ..	5,545	85,500	41,040	37,000	146,500	130,500	122,500	96.0	88.3	358	20,000	135,000	710	367	15,000	356	25,000	131.5	B	6,550	7,950	9,000	6,400	2,720	20,500	356	25,000

WEIGHTS AND PERFORMANCE—PISTON ENGINED

ER PLANT		WEIGHTS						WING LOADINGS		PERFORMANCE																		
										Best Cost (or Typical) Cruise				Speed Cruise		Range Cruise				Field length required					Range (take off to lan			
ype	T.O. Power (each)	Basic op.	Total Fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Take-off weight	Landing weight	Speed	Alt.	Weight	Con-sumption	Speed	Alt.	Speed	Alt.	Approach speed	Ref.	Take off			Landing I.S.A. s.l.	With max. fuel				
																				I.S.A. s.l.	I.S.A. + 15°C. s.l.	I.S.A. 5,000 ft.		Range	Payload	Speed	Alt.
	h.p.	lb.	lb.	lb.	lb.	lb.	lb.	lb./sq. ft.	lb./sq. ft.	knots	ft.	lb.	l.g./h.	knots	ft.	knots	ft.	knots		ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.
GSO-540-B1A	380	4,830	1,340	—	8,000	—	—	31.37	—	208	10,000	—	38	217	10,000	174	10,000	85	D	2,170	—	—	1,900	1,020	1,700	208	10,000
2000-7M2 ..	1,450	41,365	14,800	17,635	73,800	64,170	59,000	50.5	43.9	180	10,000	65,000	175	—	—	—	—	93	B	5,300	5,950	7,050	2,800	3,000	10,000	177	10,000
985–AN14B	450	6,260	1,900	2,200	9,700	—	—	26.9	—	—	—	—	—	186	10,000	152	10,000	94	D	1,980	—	—	1,850	1,475	1,532	153	10,000
Queen 70	400	6,580	1,545	1,899	8,950	8,500	—	26.4	—	162	8,000	8,500	276	182	8,000	150	8,000	84	D	2,270	—	—	1,920	1,175	—	162	8,000
Queen 30	250	8,996	2,965	3,460	13,500	13,150	12,740	27.1	26.4	159	8,000	12,500	42	166	3,000	—	—	81	D	2,425	—	—	2,065	1,350	2,100	159	8,000
1340	600	4,368	1,282	3,220	8,000	—	—	21.3	—	111	5,000	—	—	121	—	—	—	59	D	1,310	—	—	975	755	2,140	121	5,000
2000-7M2 ..	1,450	18,260	5,040	7,700	26,000	26,000	26,000	28.5	28.5	158	7,500	26,000	89	—	—	—	—	72	F	2,640	2,940	3,670	1,540	1,100	3,000	158	7,500
GSO-480-	340	5,560	1,335	1,830	8,115	8,115	—	28.4	28.4	168	12,500	8,115	—	195	9,500	145	13,500	84	B	2,200	—	—	1,540	1,040	1,067	152	12,000
des 531/8B ..	600	10,200	1,780	4,000	14,600	14,600	—	21.8	21.8	114	5,000	—	37	—	—	—	—	70	D	1,150	—	—	1,150	662	2,500	114	5,000
GTS10-520	390	6,030	1,080	3,000	9,300	9,300	9,030	25.0	25.0	140	5,000	9,300	30	155	5,000	105	10,000	75	A	1,900	2,000	2,250	2,170	800	2,200	105	10,000

ns are based on the following requirements: A, B.C.A.R.; B, SR422B or appropriate CAR; C, ICAO; D, to and from 50 ft.; E, ground run; F, $V_1 = V_R$. Data in italic are provisional. * Weight limit. † With typical airline reserves.

ONS

off to landing) no reserves				
		With max. payload		
	Alt.	Range	Speed	Alt.
	ft.	n. mi.	knots	ft.
	36,000	2,895	—	—
	40,000	4,100	—	—
	38,400	4,000	—	—
	—	—	—	—
	39,000	4,090	—	—
	37,500	2,760	—	—
	37,500	3,650	—	—
	35,000	—	—	—
	35,000	3,470	435	35,000
	35,000	3,560	458	35,000
	35 000	4,340	450	35,000
	37,000	3,640	—	—
	37,000	2,920	—	—
	37,000	3,140	—	—
	35,000	1,530	461	35,000
	—	—	—	—
	—	—	—	—
	—	—	—	—
	—	—	—	—
	38,000	2,575	430	38,000
	35,000	1,565	390	35,000
	35,000	1,670	406	35,000
	35,000	1,780	403	35,000
	35,000	1,950	407	35,000
	35,000	2,210	411	35,000
	—	—	—	—
	—	1,250	—	—
	40,000	4,800	460	40,000

e off to landing) no reserves				
		With max. payload		
	Alt.	Range	Speed	Alt.
	ft.	n. mi.	knots	ft.
	20,000	910	295	20,000
	20,000	750	200	10,000
	—	1,400	—	—
	20,000	580	—	—
	25,000	1,050	—	—
	—	270	—	—
	28,000	3,100	349	21,000
	25,000	2,540	330	23,500
	25,000	3,745	331	25,000
	20,000	774	278	20,000
	20,000	550	235	20,000
	20,000	960	262	20,000
	25,000	2,008	253	25,000
	23,000	760	229	23,000
	23,000	370	229	23,000
	26,250	1,350	—	—
	20,000	2,360	340	20,000
	10,000	202	187	10,000
	20,000	710	250	20,000
	20,000	1,050	200	20,000
	28,000	1,150	290	20,000
	20,000	162	167	10,000
	—	—	—	—
	21,000	1,550	—	—
	24,000	1,500	290	24,000
	25,000	1,590	350	25,000

e off to landing) no reserves				
		With max. payload		
	Alt.	Range	Speed	Alt.
	ft.	n. mi.	knots	ft.
	10,000	—	—	—
	10,000	2,000	177	10,000
	10,000	958	153	10,000
	8,000	323	—	8,000
	8,000	365	—	—
	5,000	—	—	—
	7,500	—	—	—
	12,000	250	155	6,000
	5,000	75	—	—
	10,000	200	140	5,000

DIMENSIONS

AIRCRAFT	Span	Length O.A.	Height O.A.	Gross wing area	Wing sweep-back	Internal cabin (ex flight deck)					Total freight hold volume
						Length	Max. width	Max. height	Floor area	Usable volume	
TURBOJET	ft. in.	ft. in.	ft. in.	sq. ft.	deg.	ft. in.	in.	in.	sq. ft.	cu. ft.	cu. ft.
Boeing 707–120	130 10	144 6	42 0	2,433	35	104 10	139	90.9	1 093	7,653	1,660 (2)
Boeing 707–320/420	142 5	152 11	41 8	2,892	35	111 6	139	90.9	1,164	8,151	1,700 (2)
Boeing 707–320B	145 8½	152 11	42 5½	2,942	35	111 6	139	90.9	1,164	8,151	1,700 (2)
Boeing 720	130 10	136 2	41 6½	2,433	35	96 6	139	90.9	1,003	7,030	1,390 (2)
Boeing 727	108 7	135 5	34 0	1,650	32	72 8	139	90.9	—	—	850 (2)
Convair 880/880M	120 0	129 4	36 4	2,000	35	89 3	128	85	803	4,570	863 (2)
Convair 990	120 0	134 9	39 6	2,250	35	98 9	128	85	1,007	6,113	928 (2)
D.H. Comet 4B	107 10	118 0	29 6	2,059	20	78 3	116	79	529	3,160	640 (3)
D.H. Comet 4C	114 9	118 0	29 6	2,121	20	78 3	116	79	529	3,160	640 (3)
D.H. Trident 1	89 10	114 9	27 0	1,358	35	66 6	135.5	80	708	4,440	620 (2)
Douglas DC–8	142 5	150 6	42 4	2,771	30	103 0	140	80	1,100	7,945	1,390 (2)
Lockheed JetStar	53 8	60 5½	20 6	542.5	30	28 2	69	72.5	100	700	Nil
Sud Caravelle III, VI, X	112 6	105 0	28 7	1,579	20	72 0	118.5	82	646	4,200	534 (4)
Sud Caravelle VII	112 6	108 0	28 7	1,579	20	75 0	118.5	82	675	4,400	640 (4)
Tupolev Tu–104	113 4	127 6	39 4½	*1,825*	36	—	126	83	—	5,650	530
Vickers VC10	140 0	158 10	39 1½	2,800	32.5	91 4	138	90	—	6,700	1,350 (2)
TURBOPROP											
Allison-Convair	105 4	81 6	29 2	920	Nil	43 1	113	79.2	380	2,178	514 (4)
A.W. 650 Argosy	115 0	86 9	27 0	1,458	Nil	46 8	120	80	426	3,680	Nil
Antonov An–10A	124 8	121 4	32 1	1,293	—	—	—	108	—	—	1,483
Avro 748	95 0	67 0	24 10	795	Nil	46 6	96.5	76	296	1,990	Nil
Breguet 941C	76 1	74 8½	30 8½	887	Nil	39 1½	96	89	286	2,120	160
Bristol Britannia 320	142 3½	124 3	37 4½	2,075	7	86 3	139	80	883	5,877	819 (2)
Canadair CL–44D	142 3½	136 8	38 7	2,075	7	98 1	137	81.5	1,080	6,239	1,109 (2)
Canadair 540	105 4	79 2	28 2	920	4.33	54 10	107	79	396	2,515	402 (4)
Fokker F–27	95 2	75 9	27 11	754	Nil	47 6	100	78.8	312*	2,130*	Nil
Grumman Gulfstream	78 4	64 6	22 9	615	Nil	33 0	88	73	177	1,040	125 (2)
H.P.R.7 Herald 100	94 4½	71 11	24 0	886	Nil	38 4	104	76	245	1,744	212 (2)
H.P.R.7 Herald 200	94 4½	75 5	24 0	886	Nil	—	104	76	254	1,802	285 (2)
Ilyushin Il–18B	122 8½	117 9	33 4	1,507	Nil	*85 0*	127	73	—	4,940	1,200 (3)
Lockheed Electra	99 0	104 8	32 10½	1,300	Nil	76 5	128	85	704	4,812	528 (2)
M.H.260 S. Broussard	71 8	58 1	21 0	592	Nil	21 4	86	73	148.5	833	99 (1)
Namco YS–11	105 0	86 3	30 0	1,020	Nil	44 1	106	78	340.3	2,124	287 (3)
Potez 840	63 8	51 3	18 3	377	Nil	23 0	71	69	91	670	63.5 (2)
Short Belfast	158 9½	136 5	47 0	2,466	7.05	84 6	184	160	1,012	10,000	Nil
Sipa Presence	57 1	45 7	15 1	355	Nil	21 0	84	67	129	635	Nil
Transall C.160	131 3	102 0	38 6	1,722	Nil	42 8	124	117	—	4,837	Nil
Tupolev Tu–114	*177 2*	*154 10*	*38 8½*	*3,350*	*35*	*154 2*	*148*	—	—	*16,420*	2,472 (2)
Vickers Viscount 700	93 8½	81 10	26 9	963	Nil	45 0	119	78	430	2,230	358 (2)
Vickers Viscount 810	93 8½	85 8	26 9	963	Nil	54 0	117	78	520	2,680	370 (2)
Vickers Vanguard	118 0	122 10½	34 11	1,529	Nil	90 0	128.8	82.5	893	5,690	1,360 (2)
PISTON-ENGINED											
Aero Commander 680F	49 6	35 1½	14 6	255	Nil	10 7½	52	53	—	177	32 (1)
Aviation Traders Carvair	117 6	102 7	30 0	1,462	Nil	80 2	116	81	665	4,350	151 (1)
Beech G18S	49 8	35 2½	9 8	361	Nil	10 5	52	66	—	—	24 (1)
D.H.104 Dove 8	57 0	39 6	13 4	335	Nil	12 3	54	63	—	—	22 (1)
D.H.114 Heron 2	71 6	48 6	15 7	499	Nil	23 0	54	69	89	515	127 (2)
D.H. C.3 Otter	58 0	41 10	13 0	375	Nil	12 8	62	59	—	272	38 (1)
D.H. C.4 Caribou	96 0	72 7	31 9	912	Nil	28 9	87	75	175	1,150	Nil
Piaggio P.166	46 9	38 1	16 5	286	6	11 8½	62	69	—	300	87.3 (2)
Scottish Twin Pioneer 3	76 6	45 3	18 0	670	Nil	22 8	72	69	129	730	96 (1)
Short Skyvan	64 1	38 11	13 10	373	Nil	16 0	78	78	104	675	Nil
HELICOPTER	‡	‡		‡							
Sikorsky S.61L	62 0	54 9	15 4	3,019	—	31 11	78	75.5	—	1,040	59 (1)
Sud Frelon	49 2½	48 10½	15 5	1,894	—	22 11½	74.75	72	139	—	Nil
Vertol 107–II	50 0	44 7	16 10	1,995	—	24 2	79	72	145	860	Nil
Westland B.192C	48 11	57 2	17 4	1,880	—	24 0	68[2]	74[3]	—	720	100 (1)
Westland Rotodyne 2	109 0[3]	69 5	27 3	9,340	Nil	52 9	116.5	84	480	3,360	Nil
Westland Wessex 2	56 0	65 10	15 11	2,460	—	15 6	60	70	—	—	Nil

[1] Excludes toilet and galley. [2] Unfurnished. [3] Wing span 75 ft. 0 in. * Gross. ‡ Rotor diameter, length without rotor, rotor disc area. Data in italics are provisional.

WEIGHTS AND PERFORMANCE—MULTI-ENGINE TURBINE HELICOPTERS

	VERTOL 107–II†	SIKORSKY S.61L	WESTLAND 192C*	WESTLAND ROTODYNE	WESTLAND WESSEX 2
WEIGHTS (for 100 ft./min. climb, s.l., with one engine inoperative)*					
Operating weight empty (lb.)	10,425	9,270	12,332	—	8,126
Max. internal fuel (lb.)	—	2,835	4,800	10,250	2,400
Max. payload (lb.)	8,000	8,900	7,007	17,500	5,374
Max. take-off weight (lb.)	18,450	18,700	19,000	58,500	13,500
Max. landing weight (lb.)	18,450	18,700	19,000	58,500	13,500
Disc loading (max. t.-o. wt.) (lb./sq. ft.)	4.62	6.2	5.05	6.26	6.4
PERFORMANCE (I.S.A., sea level)					
Best economical cruising speed (knots)	135	118	120	200	100
at altitude at mean weight (ft./lb.)	1,000/–	0/17,500	2,000/19,000	5,000/–	0/13,500
at power, h.p., with consumption, Imp. gal./hr.	—	1,400/142	1,960/187	—	–/103
Initial climb, vertical (ft./min.)	1,240	600	450	2,150	450
Initial climb, inclined (ft./min.)	1,700	1,600	1,000	—	1,500
Best climb with one engine out (ft./min.)	—	300	500‡	—	940
Hovering ceiling, out of ground effect (ft.)	—	5,000	5,500	9,000	10,000
Hovering ceiling, in ground effect (ft.)	7,800	7,000	9,000	—	13,000
Service ceiling (ft.)	13,700	9,500	13,500	—	17,500
Range (no reserves, max. fuel) at speed (naut. mi./knots)	250/–	270/118	400/120	575	300/100
at altitude with payload (ft./lb.)	0/6,000	0/–	2,000/2,000	—	0/2,974
Power plant	2×CT58–110	2×CT58–110	2×Gazelle 2	2×Tyne	2×Gnome
Max. t.-o. power (h.p./r.p.m.)	1,250/19,500	1,250/19,500	—	—	1,050/–
Max. contingency rating (h.p./r.p.m.)	—	1,250/19,500	1,650/–	—	1,350/–

* Westland 192C data are based on a 320 ft./min. climb with one engine inoperative and the other on intermediate contingency power at sea level. † Brochure data, not necessarily uniform with remainder of tabulation. ‡ Using max. contingency power.

DIMENSIONS

AIRCRAFT	Span	Length O.A.	Height O.A.	Gross wing area	Wing sweep-back	Internal cabin (ex flight deck)				Total freight hold volume
						Length	Max. width	Max. height	Floor area	Usable volume	
TURBOJET	ft. in.	ft. in.	ft. in.	sq. ft.	deg.	ft. in.	in.	in.	sq. ft.	cu. ft.	cu. ft.
Boeing 707–120	130 10	144 6	42 0	2,433	35	104 10	139	90.9	1 093	7,653	1,660 (2)
Boeing 707–320/420	142 5	152 11	41 8	2,892	35	111 6	139	90.9	1,164	8,151	1,700 (2)
Boeing 707–320B	145 8½	152 11	42 5½	2,942	35	111 6	139	90.9	1,164	8,151	1,700 (2)
Boeing 720	130 10	136 2	41 6½	2,433	35	96 6	139	90.9	1,003	7,030	1,390 (2)
Boeing 727	108 7	135 5	34 0	1,650	32	72 8	139	90.9	—	—	850 (2)
Convair 880/880M	120 0	129 4	36 4	2,000	35	89 3	128	85	803	4,570	863 (2)
Convair 990	120 0	134 9	39 6	2,250	35	98 9	128	85	1,007	6,113	928 (2)
D.H. Comet 4B	107 10	118 0	29 6	2,059	20	78 3	116	79	529	3,160	640 (3)
D.H. Comet 4C	114 9	118 0	29 6	2,121	20	78 3	116	79	529	3,160	640 (3)
D.H. Trident 1	89 10	114 9	27 0	1,358	35	66 6	135.5	80	708	4,440	620 (2)
Douglas DC-8	142 5	150 6	42 4	2,771	30	103 0	140	80	1,100	7,945	1,390 (2)
Lockheed JetStar	53 8	60 5½	20 6	542.5	30	28 2	69	72.5	100	700	Nil
Sud Caravelle III, VI, X	112 6	105 0	28 7	1,579	20	72 0	118.5	82	646	4,200	534 (4)
Sud Caravelle VII	112 6	108 0	28 7	1,579	20	75 0	118.5	82	675	4,400	640 (4)
Tupolev Tu–104	113 4	127 6	39 4½	*1,825*	36	—	126	83	—	5,650	530
Vickers VC10	140 0	158 10	39 1½	2,800	32.5	91 4	138	90	—	6,700	1,350 (2)
TURBOPROP											
Allison-Convair	105 4	81 6	29 2	920	Nil	43 1	113	79.2	380	2,178	514 (4)
A.W. 650 Argosy	115 0	86 9	27 0	1,458	Nil	46 8	120	80	426	3,680	Nil
Antonov An–10A	124 8	121 4	32 1	1,293	—	—	—	108	—	—	1,483
Avro 748	95 0	67 0	24 10	795	Nil	46 6	96.5	76	296	1,990	Nil
Breguet 941C	76 1	74 8½	30 8½	887	Nil	39 1½	96	89	286	2,120	160
Bristol Britannia 320	142 3½	124 3	37 4½	2,075	7	86 3	139	80	883	5,877	819 (2)
Canadair CL–44D	142 3½	136 8	38 7	2,075	7	98 1	137	81.5	1,080	6,239	1,109 (2)
Canadair 540	105 4	79 2	28 2	920	4.33	54 10	107	79	396	2,515	402 (4)
Fokker F–27	95 2	75 9	27 11	754	Nil	47 6	100	78.8	312*	2,130*	Nil
Grumman Gulfstream	78 4	64 6	22 9	615	Nil	33 0	88	73	177	1,040	125 (2)
H.P.R.7 Herald 100	94 4½	71 11	24 0	886	Nil	38 4	104	76	245	1,744	212 (2)
H.P.R.7 Herald 200	94 4½	75 5	24 0	886	Nil	—	104	76	254	1,802	285 (2)
Ilyushin Il–18B	122 8½	117 9	33 4	1,507	Nil	*85 0*	127	73	—	4,940	1,200 (3)
Lockheed Electra	99 0	104 8	32 10½	1,300	Nil	76 5	128	85	704	4,812	528 (2)
M.H.260 S. Broussard	71 8	58 1	21 0	592	Nil	21 4	86	73	148.5	833	99 (1)
Namco YS–11	105 0	86 3	30 0	1,020	Nil	44 1	106	78	340.3	2,124	287 (3)
Potez 840	63 8	51 3	18 3	377	Nil	23 0	71	69	91	670	63.5 (2)
Short Belfast	158 9½	136 5	47 0	2,466	7.05	84 6	184	160	1,012	10,000	Nil
Sipa Presence	57 1	45 7	15 1	355	Nil	21 0	84	67	129	635	Nil
Transall C.160	131 3	102 0	38 6	1,722	Nil	42 8	124	117	—	4,837	Nil
Tupolev Tu–114	*177 2*	*154 10*	*38 8½*	*3,350*	*35*	*154 2*	*148*	—	—	*16,420*	2,472 (2)
Vickers Viscount 700	93 8½	81 10	26 9	963	Nil	45 0	119	78	430	2,230	358 (2)
Vickers Viscount 810	93 8½	85 8	26 9	963	Nil	54 0	117	78	520	2,680	370 (2)
Vickers Vanguard	118 0	122 10½	34 11	1,529	Nil	90 0	128.8	82.5	893	5,690	1,360 (2)
PISTON-ENGINED											
Aero Commander 680F	49 6	35 1½	14 6	255	Nil	10 7½	52	53	—	177	32 (1)
Aviation Traders Carvair	117 6	102 7	30 0	1,462	Nil	80 2	116	81	665	4,350	151 (1)
Beech G18S	49 8	35 2½	9 8	361	Nil	10 5	52	66	—	—	24 (1)
D.H.104 Dove 8	57 0	39 6	13 4	335	Nil	12 3	54	63	—	—	22 (1)
D.H.114 Heron 2	71 6	48 6	15 7	499	Nil	23 0	54	69	89	515	127 (2)
D.H. C.3 Otter	58 0	41 10	13 0	375	Nil	12 8	62	59	—	272	38 (1)
D.H. C.4 Caribou	96 0	72 7	31 9	912	Nil	28 9	87	75	175	1,150	Nil
Piaggio P.166	46 9	38 1	16 5	286	6	11 8½	62	69	—	300	87.3 (2)
Scottish Twin Pioneer 3	76 6	45 3	18 0	670	Nil	22 8	72	69	129	730	96 (1)
Short Skyvan	64 1	38 11	13 10	373	Nil	16 0	78	78	104	675	Nil
HELICOPTER	‡	‡		‡							
Sikorsky S.61L	62 0	54 9	15 4	3,019	—	31 11	78	75.5	—	1,040	59 (1)
Sud Frelon	49 2½	48 10½	15 5	1,894	—	22 11½	74.75	72	139	—	Nil
Vertol 107–II	50 0	44 7	16 10	1,995	—	24 2	79	72	145	860	Nil
Westland B.192C	48 11	57 2	17 4	1,880	—	24 0	68[2]	74[3]	—	720	100 (1)
Westland Rotodyne 2	109 0[3]	69 5	27 3	9,340	Nil	52 9	116.5	84	480	3,360	Nil
Westland Wessex 2	56 0	65 10	15 11	2,460	—	15 6	60	70	—	—	Nil

[1] Excludes toilet and galley. [2] Unfurnished. [3] Wing span 75 ft. 0 in. * Gross. ‡ Rotor diameter, length without rotor, rotor disc area. Data in italics are provisional.

WEIGHTS AND PERFORMANCE—MULTI-ENGINE TURBINE HELICOPTERS

	VERTOL 107–II†	SIKORSKY S.61L	WESTLAND 192C*	WESTLAND ROTODYNE	WESTLAND WESSEX 2
WEIGHTS (for 100 ft./min. climb, s.l., with one engine inoperative)*					
Operating weight empty (lb.)	10,425	9,270	12,332	—	8,126
Max. internal fuel (lb.)	—	2,835	4,800	10,250	2,400
Max. payload (lb.)	8,000	8,900	7,007	17,500	5,374
Max. take-off weight (lb.)	18,450	18,700	19,000	58,500	13,500
Max. landing weight (lb.)	18,450	18,700	19,000	58,500	13,500
Disc loading (max. t.-o. wt.) (lb./sq. ft.)	4.62	6.2	5.05	6.26	6.4
PERFORMANCE (I.S.A., sea level)					
Best economical cruising speed (knots)	135	118	120	200	100
at altitude at mean weight (ft./lb.)	1,000/–	0/17,500	2,000/19,000	5,000/–	0/13,500
at power, h.p., with consumption, Imp. gal./hr.	—	1,400/142	1,960/187	—	–/103
Initial climb, vertical (ft./min.)	1,240	600	450	2,150	450
Initial climb, inclined (ft./min.)	1,700	1,600	1,000	—	1,500
Best climb with one engine out (ft./min.)	—	300	500‡	—	940
Hovering ceiling, out of ground effect (ft.)	—	5,000	5,500	9,000	10,000
Hovering ceiling, in ground effect (ft.)	7,800	7,000	9,000	—	13,000
Service ceiling (ft.)	13,700	9,500	13,500	—	17,500
Range (no reserves, max. fuel) at speed (naut. mi./knots)	250/–	270/118	400/120	575	300/100
at altitude with payload (ft./lb.)	0/6,000	0/–	2,000/2,000	—	0/2,974
Power plant	2×CT58–110	2×CT58–110	2×Gazelle 2	2×Tyne	2×Gnome
Max. t.-o. power (h.p./r.p.m.)	1,250/19,500	1,250/19,500	—	—	1,050/–
Max. contingency rating (h.p./r.p.m.)	—	1,250/19,500	1,650/–	—	1,350/–

* Westland 192C data are based on a 320 ft./min. climb with one engine inoperative and the other on intermediate contingency power at sea level. † Brochure data, not necessarily uniform with remainder of tabulation. ‡ Using max. contingency power.

VERSATILE POWER

The change to jet-prop Napier Elands in the Canadair/Convair 540 has led to all-round gains in flight economy and performance. In addition to its roles as military transport with the R.C.A.F., and airliner with Allegheny Airlines and Quebecair, the Convair is also readily convertible to an all-cargo version or an executive aircraft. Napier power, in fact, is versatile power.

NAPIER ELAND

The Napier Eland propeller turbine, type-approved at 3,500 e.h.p., has been developed for both fixed *and* rotating-wing aircraft. In the latter application it powers both the Rotodyne and Westland Westminster.

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WHAT DO YOU KNOW ABOUT HEATHROW?

Why call London Airport "Heathrow"?

Because there are two London Airports now—Heathrow and Gatwick—so 'LAP' has become London (Heathrow) Airport. And today, as jet airliners depart from London to span oceans and continents in a matter of hours, the name of Heathrow revives memories of a more leisurely age of less exotic transport: when, two hundred years ago, mail coaches took the Bath Road across Hounslow Heath, past the "Three Magpies" which still stands near the airport entrance, on the three-day long-haul run between London and Bath.

How long has it been an airport?

First built as an airfield for R.A.F. Transport Command in 1944, on the site of the Fairey Aviation Company's small grass aerodrome known in the 1930's as Harmondsworth (Heathrow), it was taken over by the Ministry of Civil Aviation at the end of 1945. The first proving flight was made in January, 1946 and the first passenger service was flown on June 1 of the same year.

How big is it now?

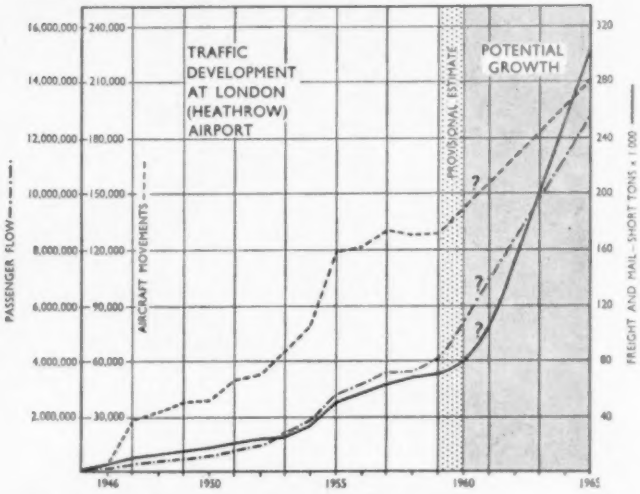
The airport covers 2,705 acres with a boundary length of 12 miles. There is enough concrete in the five runways, roads and taxyways to build a first-class road from London to Edinburgh. It's a town in itself and a busy one at that, with its own fire service, police force and bye-laws, a telephone exchange and a total staff of 28,000.

What's going on in the picture below?

This shows an Esso crewman in the control compartment of a Python refueller. These 55-foot-long Pythons are a familiar sight at London (Heathrow). Each has a capacity of 12,000 Imperial gallons. High-speed hydraulic motors drive the two centrifugal delivery pumps to provide a pumping rate of 1,000 gallons a minute—500 from each of two hoses. As always, precise filtration is a key factor in Esso service and all fuel supplied by the Python passes through 2½-micron filter separators.

How has traffic developed since 1946?

This graph gives the answer:



Today aircraft of 46 of the World's airlines make regular use of Heathrow and the airport is the busiest in the World outside the U.S.A.

What about Esso's share in all this?

With a staff of 130 and a fleet of nearly fifty refuellers, trailers and other mobile dispensing equipment to suit every need however large or small, Esso handles a million gallons of fuel a week at Heathrow. Its storage tanks at the Perry Oaks fuel farm hold this amount—plus nearly half as much again in the tanks at the Central Area Plant. And out at Perry Oaks Esso now has its own manufacturing plant for water methanol and demineralised water.

And how about the future?

Airport facilities are expanding rapidly. No. 5 runway is being extended to 11,000 feet, the long-haul passenger building now under construction in the Central Area is due for completion soon and a new permanent freight building should be ready in 1963. As for Esso's plans, they are based on the determination to stay two steps ahead of current demands, to provide safe service fast whatever the need and ensure that fuel service will never be a limiting factor for the rapidly-growing air traffic of tomorrow.

Esso Petroleum Company Limited,
Aviation Division,
36 Queen Anne's Gate, London S.W.1
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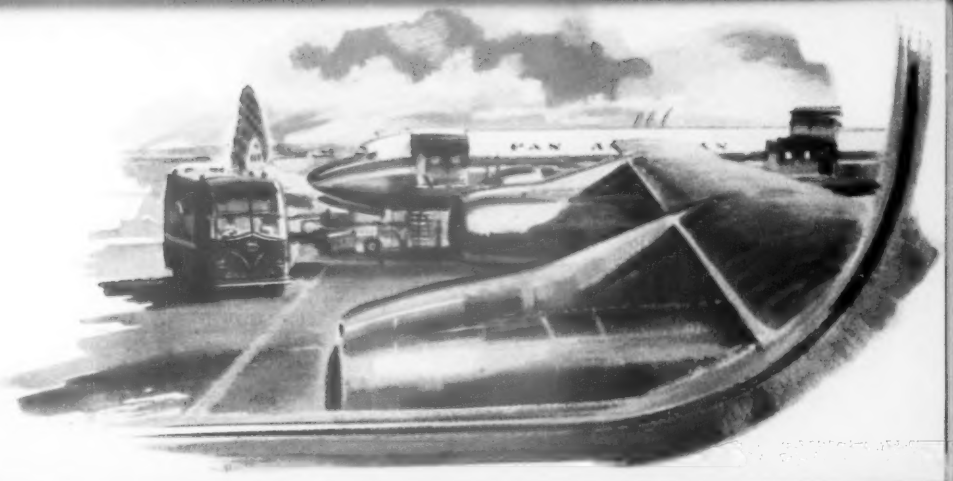
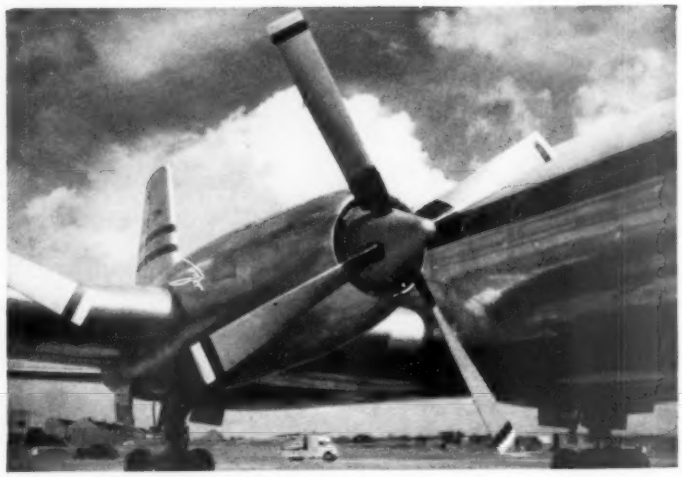
Advertisement



At the receiving end of calculated hustle: view from a cabin window of a Boeing 707 on the fuelling apron.

1615 on a winter's day at London Airport. A Boeing 707 of T.W.A. en route Frankfurt-New York receives fast Esso service.

The success of FLEXFLYTE *in the air...*



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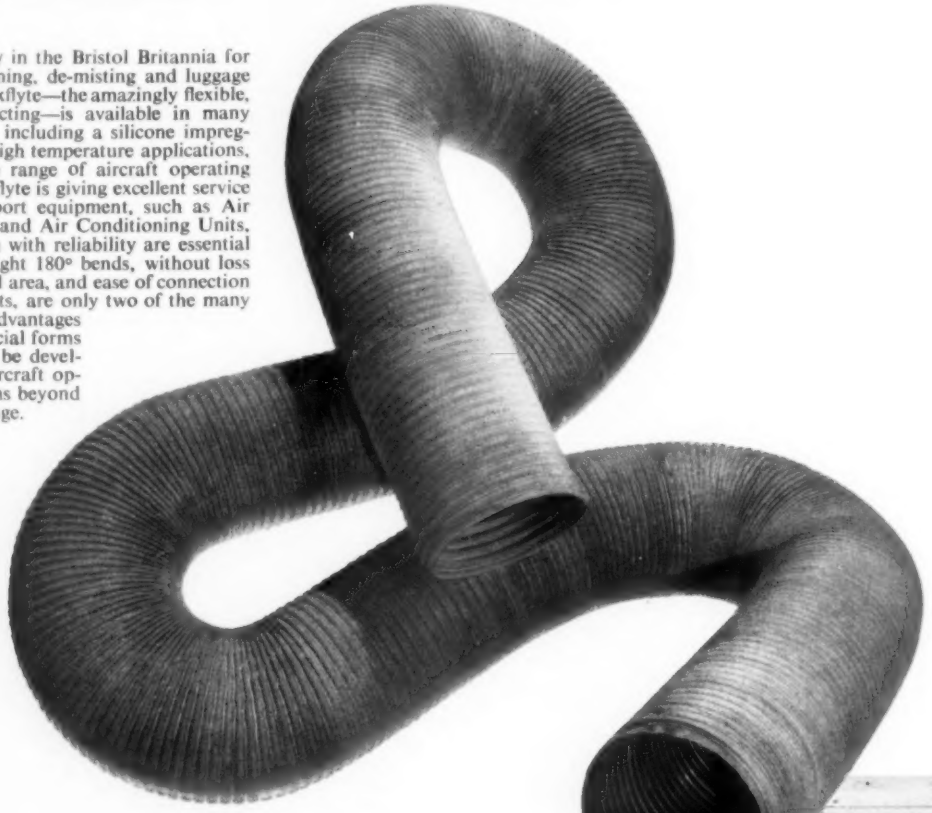
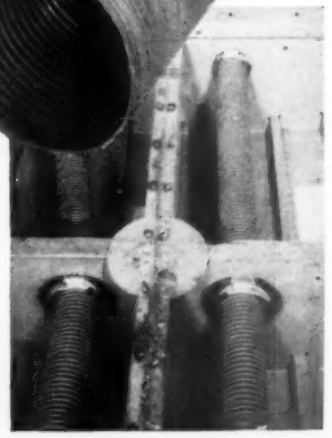
Used extensively in the Bristol Britannia for Cabin Conditioning, de-misting and luggage bay heating, Flexflyte—the amazingly flexible, light weight ducting—is available in many standard forms, including a silicone impregnated type for high temperature applications, to meet a wide range of aircraft operating conditions. Flexflyte is giving excellent service on ground support equipment, such as Air Starter Trolleys and Air Conditioning Units, where toughness with reliability are essential requirements. Tight 180° bends, without loss of cross sectional area, and ease of connection to rigid tube units, are only two of the many installational advantages of Flexflyte. Special forms of Flexflyte can be developed to meet aircraft operating conditions beyond the Standard range.





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AVICA

Commercial Aircraft . . . .

(*Continued from page 400*)

BOEING 731. Boeing submitted this project design for the SOR 182, MATS jet freighter, requirement. It had a high wing, turbofan engines and a unique "kneeling" undercarriage to bring the fuselage down to ground level for loading. No further development is expected without official support.

BOEING 735. Numerous pure freighter variants of the 707 family have been studied under this designation, but no decision to build has yet been taken. Swing-tail rear loading is available, and turbofan engines would probably be used, in a version paralleling the 707-320B or 707-520B. Payloads of up to 90,000 lb. could be carried in gross-weight operations at 315,000 lb.

BOEING 737/747. Some design studies have been made by Boeing of a short-haul feederline jet transport, in a similar category to the BAC-107 and Avro 771. This has been variously reported as the Boeing 737 and Boeing 747. No details are available.

British Aircraft Corporation BAC-107 (Bristol Siddeley BS75).

BOEING 909. This unofficial designation is reported for a design study by the Boeing Wichita Division for a turbojet executive aircraft. No further details are available.

BREGUET 941/942. The prototype STOL Breguet 941, ordered by the French Air Ministry on Feb. 22, 1960, is expected to be seen at the Paris Aero Show, together with a full-scale mock-up of the Breguet 942 in Air Inter colours. The two aircraft are similar in all respects other than the fuselage, which in the Br. 942 is of circular cross-section and pressurized. Seating 50-55 passengers (five abreast), the Br. 942's cabin has an inside diameter of 9 ft. 6 in. and headroom of 6 ft. 5 in. By comparison, the passenger-carrying Br. 941 seats 48 in a cabin of approximately square cross-section. The Br. 941 freighter is dimensionally similar with rear-loading clam-shell doors. Direct operating costs of the Br. 942 have been calculated (A.T.A. method) to be 1.6 cents/passenger mile for a 500-mile sector.

Development of the deflected slipstream principle for the Br. 941/942 is aided by the research programme with the smaller Br. 940, which first flew in May, 1958. Trials with this prototype resumed on Feb. 23, 1961, after modification to test features of the Br. 941/942 and 945.

Bristol Britannia 317 (Bristol Siddeley Proteus).

BREGUET 945. Newest member of the "Breguet 94" family, the Br. 945 is designed for military use but might have application as a highly specialized STOL freighter in difficult country. Its characteristics with two 1,300-h.p. Turmo IIID turboprops include: gross weight, 22,000 lb.; span, 66 ft. 9 in.; length, 54 ft. 5 in.; cruising speed, 215 knots; range with 3,300-lb. payload, 810 naut. miles.

BRISTOL BRITANNIA. The sale of two Britannias to Ghana Airways during 1960 brought to an end the marketing of commercial Britannias and production of 23 for the R.A.F. by Bristol and Short Bros. has since been completed. A market in second-hand Britannias is now developing, as indicated by the recent purchase of two by Cunard Eagle from Canadian Pacific.

BRITISH AIRCRAFT CORPORATION BAC-107. Stemming from an original Hunting Aircraft design study of some five years' currency, the short-haul turbofan BAC-107 has been extensively revised in the past 12 months as a joint Hunting-Vickers project within the British Aircraft Corporation. It is now available as a developed design for immediate construction. Broadly, the BAC-107 will be a 50/60-seat aeroplane with two rear-mounted Bristol Siddeley BS75 turbofans and a low, moderately swept wing. It is seen as a Convair/Viscount replacement having direct operating costs of 1.2 cents or lower per seat/mile over ranges of about 600 miles; the design range with full payload would be about 1,000 miles.

BRITISH AIRCRAFT CORPORATION BAC-111. This is a slightly larger version of the BAC-107, based on two R.-R. Spey turbojets and with a full-payload range of some 1,500 miles. Its development is expected to proceed as a joint private/Government venture and full details are to be announced shortly.

CANADAIR FORTY-FOUR. A year and a day after the first flight of the R.C.A.F.'s first CL-44 (12 have been ordered) Canadair flew the first of the commercial swing-tail CL-44D versions on Nov. 16, 1960. The Forty-Four, derived from the original Britannia, but with a longer fuselage and R.-R. Tyne

Above, Canadair CL-44 (Rolls-Royce Tyne).

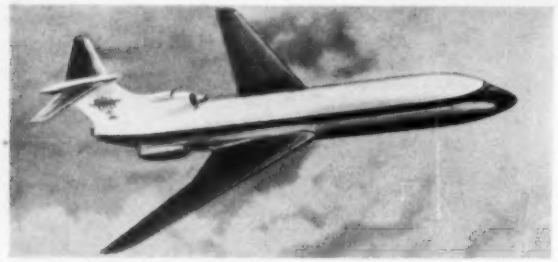
Above, right, Canadair 540 (Napier Eland).

Right, Convair 880 (General Electric CJ805-3).

Commercial Aircraft . . . .

Right, Convair 990 (General Electric CJ805-23).

Below, de Havilland D.H.121 Trident (Rolls-Royce Spey).



engines, is the largest pure freighter purchased to date for commercial service, and the largest application of the swing-tail principle for straight-in loading. Certification is to be completed by mid-1961 and delivery of all 17 at present on order will be made between then and the end of this year. (See our issue for Nov. 27, 1959.)

CANADAIR 540. Production deliveries to the R.C.A.F. of the Eland-engined Convair 440 built by Canadair began in 1960. Similar aircraft are available for commercial use as 48/58-seaters, but those now in service with Allegheny, Quebecair and Butler Aviation are conversions of original Convair airframes rather than Canadair-built examples. Such conversions are marketed by Napier Inc., and those for Allegheny were modified by AiResearch Division of Garrett Corporation.

CONVAIR 880. Delivery of 37 Convair 880s to Delta, T.W.A. and Northeast is nearly complete. These are the original 88/120-seat version (first flown on Jan. 27, 1959), for which no further orders have been placed. Production now is concentrated on the 107/120-seat Model 22-M, or Convair 880-M, which incorporates several features originally planned for the long-range 880 Model 31, now discontinued. These changes comprise uprated CJ-805-3B engines; leading-edge slats; power-boosted rudder; provision for centre-section fuel tanks; a stronger undercarriage for higher take-off and landing weights, with a proportional anti-skid unit; and a retractable tail skid. The first 880-M flew at San Diego on Oct. 3, 1960, and deliveries will begin in the near future.

CONVAIR 990 CORONADO. Originally developed as the Model 30, or Convair 600, this larger member of the 880 family was re-numbered last year for sales-promotion purposes.

Above, de Havilland D.H.106 Comet 4C (Rolls-Royce Avon).

Right, Douglas DC-8 Srs. 30 (Pratt & Whitney JT4A-3).

Changes from the 880 are a longer fuselage for 104/131 passengers; an increase in wing chord to reduce the t/c ratio to 8%; anti-shock bodies on the wings; increased fuel; and turbofan engines. The first 990 entered the flight-test stage on Jan. 24, 1961. Certification is not expected before December, to allow time for the introduction of modifications shown necessary by preliminary flight trials. These include addition of Krueger-type plate flaps on the leading edge between fuselage and inner pylons to increase elevator effectiveness, and shortening the outer pylons by moving the engines back 29 in. The first 990 was laid up for these modifications on Mar. 21 and will fly again in May.

CONVAIR FORTY-NINER. A series of design studies has been made by Convair for a short/medium-haul jet aircraft to compete with the Boeing 727, D.H. Trident, Sud-Douglas Caravelle and similar types. These projects have included the Model 60, based on the Convair 880 wing with a shorter fuselage and two JT3D or CJ805 turbofans; and the Forty-Niner, also an 880 with shorter fuselage, four derated CJ805-3B engines and offering a 4,900-ft. field length at 135,000-lb. gross weight. A rear-engined project has also been studied recently.

DASSAULT-SUD MD-415A COMMUNAUTE. In collaboration with Sud-Aviation, Dassault has developed its original MD-415 design, which was flown as a military transport prototype on May 10, 1959. The proposed MD-415A differs from the original, having slightly increased span and length, two 1,000-h.p. Bastan IV turboprops in place of the earlier 750-h.p. versions of this engine, and a pressurized fuselage with accommodation for 21/24 passengers, three abreast. The MD-415A is offered as a feeder-liner and executive transport; with government support for the programme, a prototype could be flown early next year and production deliveries could begin in January, 1963. The project has the following characteristics: span, 59 ft. 10 in.; length, 54 ft. 6 in.; wing area, 463 sq. ft.; empty weight, 9,290 lb.; max. payload, 4,850 lb.; gross weight, 16,975 b.; cruising speed, 243 knots at 19,700 ft.; engine-out take-off to 35 ft., 2,953 ft.

DE HAVILLAND D.H. 106 COMET. All three versions of the Comet Series 4 continue in production, a total of 15 having been ordered in the past 12 months, including five for R.A.F. Transport Command. In all, 63 have now been ordered.

The Comet 4 is the basic 60/81-seat aircraft, developed from the Comet 3 prototype and used by B.O.A.C., Aerolineas Argentinas and East African Airways. The Comet 4 (G-APDA) first flew on Apr. 27, 1958, and B.O.A.C. operated the first transatlantic jet service on Oct. 4, 1958.

The Comet 4B is designed for shorter-range operations, and has the wing pinion tanks deleted. The span is reduced for higher cruising speeds at lower altitudes, and the fuselage lengthened for a maximum of 101 passengers. In addition to silencers, thrust reversers are fitted on the outer engines. The short-span configuration and thrust reversers were tested on the Comet 3, and the first of 14 production 4Bs for B.E.A. flew on Jne. 27, 1959.

The Comet 4C has the wing and fuel capacity of the original type combined with the long 72/101-seat fuselage to obtain improved payload-range performance. This variant first flew on Oct. 31, 1959, and went into service with Mexicana in January, 1960. In addition to Middle East Airlines and United Arab Airlines, the R.A.F. has ordered the Comet 4C.

(Continued on page 409)

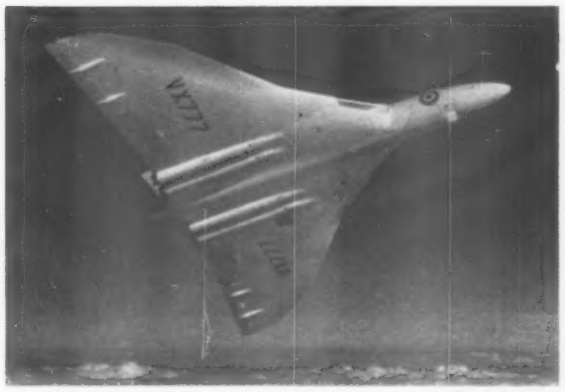
BS
AERO POWER

Olympus—for supersonic economy at Mach 2 plus

An advanced version of the Bristol Siddeley Olympus is now under intensive development for British Aircraft Corporation's TSR 2. It will give this very advanced tactical/support reconnaissance aircraft an economic performance at speeds up to Mach 2 and over.

THE RIGHT QUALITIES . . .

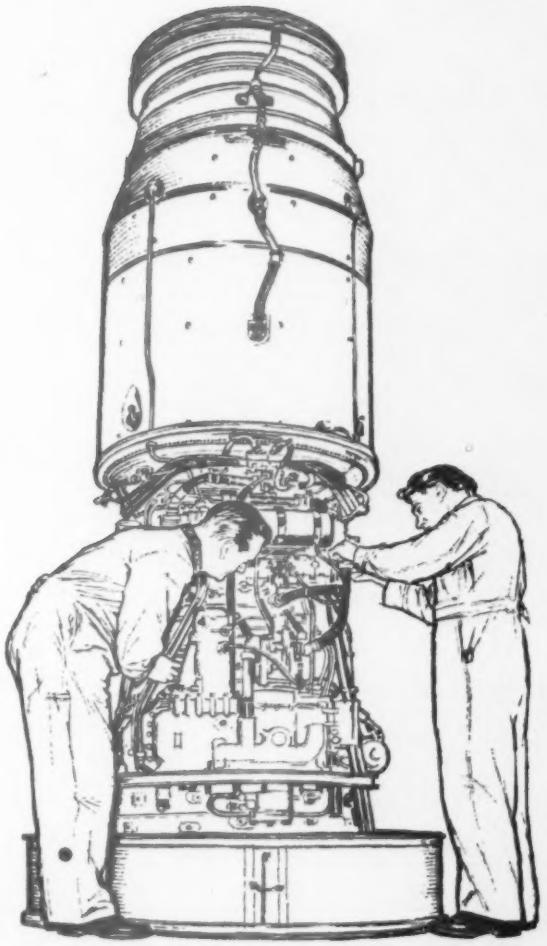
The Olympus has the ideal thermodynamic cycle for the economic propulsion of a supersonic aircraft at Mach 2 plus and embodies all the qualities essential for such an application: high power at high altitude; extremely low fuel consumption; great operational flexibility; a long overhaul life; and a very high thrust/weight ratio, and excellent handling qualities.



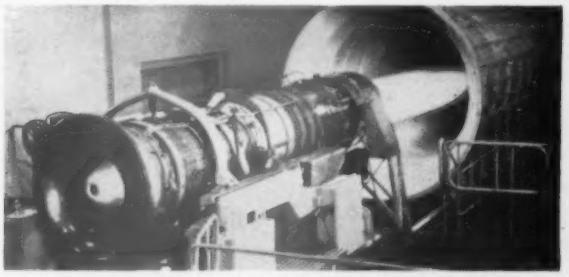
Avro Vulcan Mk 2 V-bomber.

. . . PROVED IN SERVICE

The Olympus has proved itself in several years' service, as the powerplant of the Avro Vulcan V-bomber, to be one of the most successful turbojets ever built. Maintenance is exceptionally low—last year for example, on a 26,000-mile round-the-world tour, the maintenance required was almost negligible.



The truly astonishing built-in potential of the Olympus has been confirmed by the three fold increase in power from the 11,000-lb thrust dry of the original production engine, to the 33,000-lb thrust with reheat of the latest version.



Olympus under test with reheat in operation

SUITABILITY FOR SUPERSONIC AIRLINERS

Already selected for the RAF's most up-to-date supersonic aircraft, the Olympus will clearly require only minor changes to adapt it to the requirements of a supersonic airliner in the same speed category.

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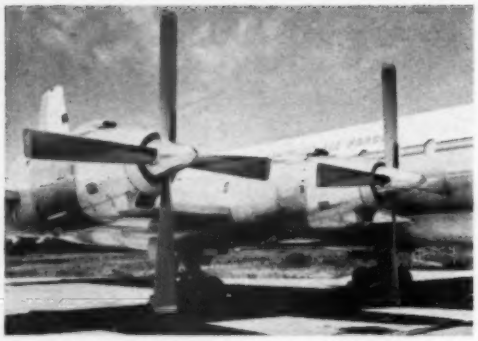
Universatility



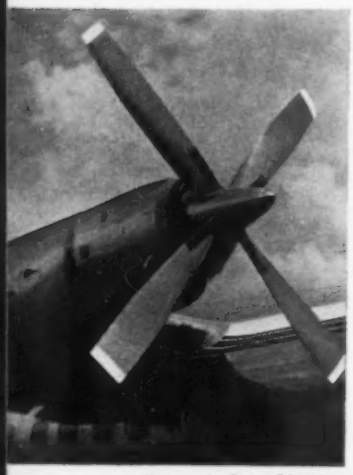
The Rolls-Royce Tyne propeller is typical of the modern turbine range.

DE HAVILLAND PROPELLERS

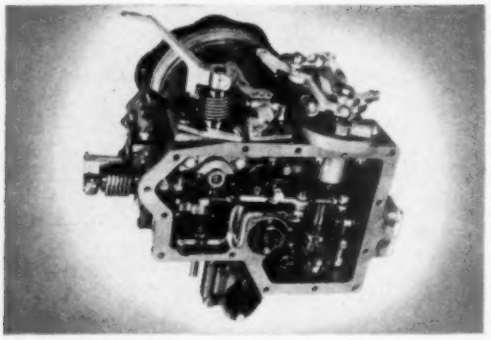
de Havilland has supplied propellers for most post-war British Civil aircraft.

Overseas, de Havilland is supplying turbine propellers for the Canadair CL 44, the Convair 540, Breguet Atlantic and Transall C.160 aircraft. At home, the Bristol Britannia, Short & Harland Belfast and Vickers Vanguard have turbine power installations driving de Havilland propellers.

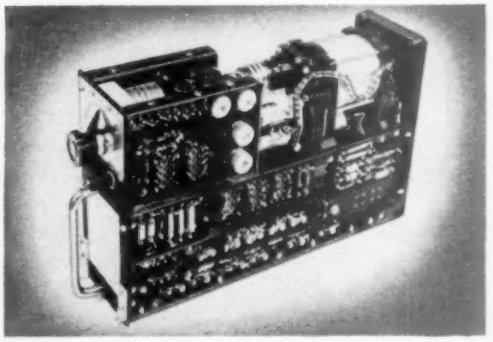
The Transall C.160 propeller is 18′ in diameter and is designed to absorb up to 7,500 s.h.p.



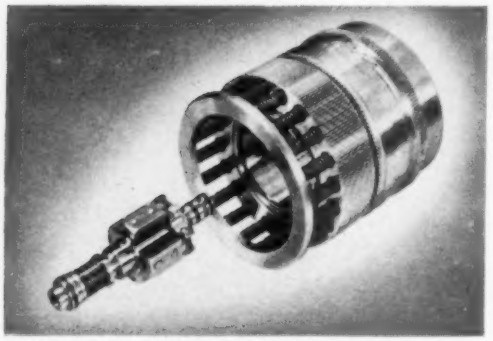
Automatic Drag Limiting System limits the drag of a windmilling propeller in the event of engine failure.



Beta (Blade Angle) Control facilitates landing and ground control by use of reverse thrust.



Synchrophasing reduces propeller induced noise and counteracts out-of-phase vibration.



Mechanical Pitch Lock limits propeller drag and prevents overspeeding in the event of propeller or oil system failure.

The de Havilland Heron two-bladed hydromatic propeller includes constant speeding and feathering features.

These and all other de Havilland

the extensive services and facilities of

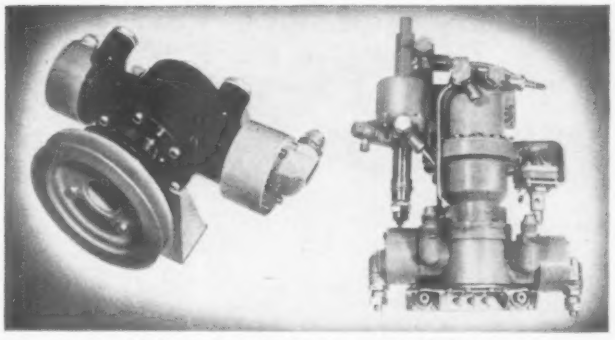
DE HAVILLAND AIR CONDITIONING

Complete Aircraft Systems and Components—Air and Vapour Cycle.

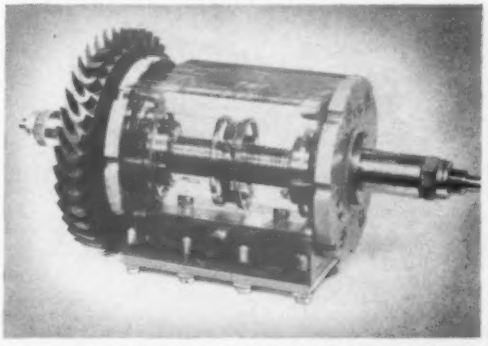
The systems for the de Havilland Trident and the Short & Harland Belfast have been engineered and are being supplied by de Havilland.

Cold air units, various types of air valves, refrigeration compressors and control valves have been supplied for many other aircraft, including the Lightning, Scimitar, Gannet, Victor, Sea Vixen, Comet and Vulcan.

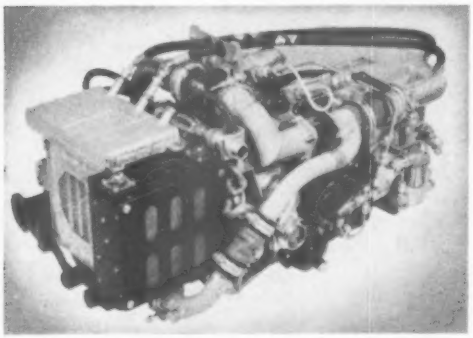
Cold Air Units with outputs from 20 lb. to 110 lb. of refrigerated air per minute.



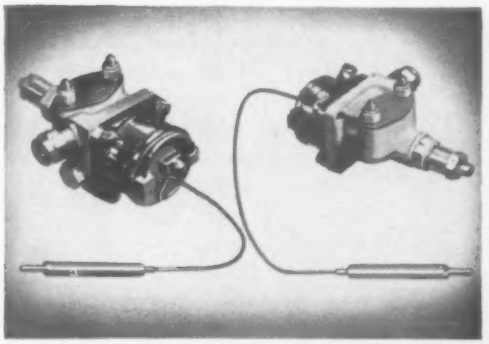
Compressors with hydraulic, electric or mechanical drive for any airborne and ground plant applications.



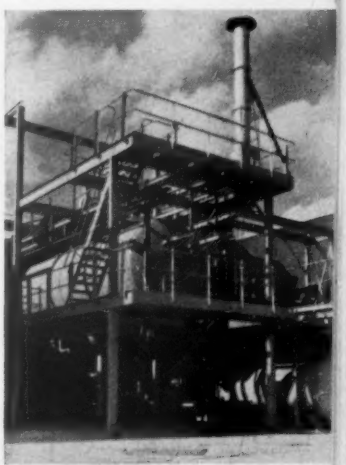
High rotational speed bearing research, leading to high cold air unit reliability.



Packaged air conditioning systems for supplying air to V-Bomber crew units.



A wide range of refrigeration valves cleared to the most stringent specifications for airborne applications, all fully vibration tested.



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WORLD AIRLINES and charter companies benefit from the speedy aircraft tyre remould service available from the Goodyear depot at London Airport. Worn covers can normally be exchanged within twelve hours for top quality Goodyear factory remoulds which have a performance equal to new tyres. On-the-spot repairs and maintenance on tyres, wheels and brakes is also carried out, all work being supervised by a staff of A.R.B.-approved engineers. Take advantage of the Goodyear Aviation Service for safer, more economical operation.

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SERVING AVIATION THE WORLD OVER

Commercial Aircraft . . . .

(*Continued from page 408*)

DE HAVILLAND D.H. 121 TRIDENT. Designed to the first B.E.A. specification for a jet transport, the short-haul D.H. 121 was named Trident in September, 1960. The name symbolizes the triple-engine layout and the triplex system philosophy for electrics and hydraulics. The 83- (mixed class)-to-100-(high density)-seat Trident is designed for autoflare, with full automatic landing capability to be added later. B.E.A. contracted for 24 D.H. 121s on Aug. 12, 1959, and the first of these is to fly in the second half of this year. Six more will join the flight-test programme in 1962 for a certification target date of early 1963 and delivery of the first six to B.E.A. by the middle of that year.

The B.E.A. Tridents will have fuel in the wings only; optional fuel capacity is available in the centre section, and if this is used the gross weight increases to 112,000 lb. This longer-range version will carry 76 passengers for 1,390 naut. miles at Mach 0.8; the B.E.A. model will fly the same load over 870 naut. miles at Mach 0.87. Few details are available of the Trident 2 project, which is reported to have been offered to U.S. and other operators requiring an aircraft of rather greater capacity and range; better field performance has been obtained by decreasing the wing sweep back and increasing the high-lift devices and, therefore, the $C_{L\ MAX}$.

When the D.H. 121 was accepted by B.E.A., the Airco consortium was set up by de Havilland, Hunting and Fairey to handle its design and manufacture. Following the acquisition of de Havillands by the Hawker Siddeley Group in 1960, Airco was dissolved and the Trident is now purely a D.H. project. In July, 1960, the Government announced that the Trident would qualify for official financial support.

DE HAVILLAND D.H.125.—It was announced last week that production of this turbojet executive aircraft (see our issue of Feb. 3, p. 107) is to be started and an initial batch of 30 is being laid down. The D.H.125 is a moderately swept, low-wing, 6/8-passenger, two-pilot aircraft with two Bristol Siddeley Viper ASV.20s mounted on the rear fuselage, and a "T"-tail. With a 390-435-knot cruising speed and a max. range of about 1,300 naut. miles, it is intended to make turbojet executive travel available at the lowest possible cost. A description and artist's impression appear elsewhere in this issue.

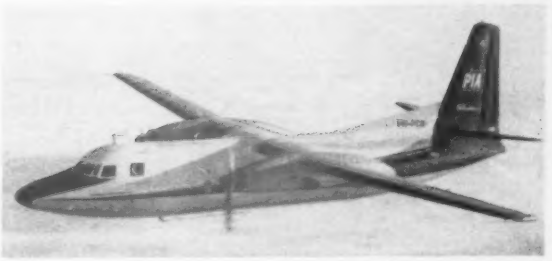
DE HAVILLAND D.H. 126. This is reported to be a larger version of the D.H. 125 design, in the general category of a "Dakota-successor," with rear-mounted turbofan engines.

DOUGLAS DC-8. An extensive programme of product improvement during 1960 has resulted in performance gains for the latest production variants of the 117/173-seat DC-8, in association with more powerful engines. The most significant modification is a 4% increase in wing chord obtained by extending the leading edge, which was introduced on the production line at the 148th aircraft and is being applied as a retrospective modification to many DC-8s already delivered. With the new wing and the latest versions of the JT4A or Conway engine, the gross weight is increased to 315,000 lb. and extra range can be obtained by the use of optional leading-edge fuel tanks.

Versions of the DC-8, and the dates on which they were certificated, are: the domestic Series 10 with JT3C-6 engines (Aug. 31, 1959); the domestic Series 20 with JT4A-3 or -9 (Jan. 19, 1960); the intercontinental Series 30 with JT4A-3, -9 or -11 (Feb. 1, 1960); and the intercontinental Series 40 with R.-R. Conway (Mar. 24, 1960). The final version is the Series 50 with JT3D-1 turbofans, first flown on Dec. 20, 1960, and to go into service later this year. (See our issue for Nov. 25, 1960.)

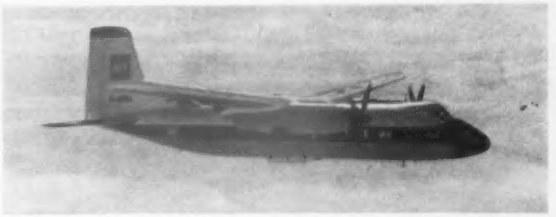
DOUGLAS DC-8A. Under this designation Douglas has prepared plans for a pure freighter version of the DC-8, turbofan-powered and with swing-tail rear loading. Gross weights up to 350,000 lb. have been projected, for payloads of more than 110,000 lb.

Lockheed Electra (Allison 501-D13).



Fokker F-27 Friendship (Rolls-Royce Dart).

Grumman Gulfstream (Rolls-Royce Dart).



Handley Page Herald (Rolls-Royce Dart).

DOUGLAS MODEL 2085. This was the Douglas design for SOR 182, the MATS jet freighter. Turbofan-powered, it had a swept-back wing, podded engines, nose loading and a gross weight of over 300,000 lb. In the absence of official acceptance, further development of the project is unlikely.

FOKKER F-27 FRIENDSHIP. Production of the F-27 by Fairchild ended in 1960, with 83 sold and 10 uncommitted aircraft built for future sale. Production by Fokker continues and recent orders have brought the total to 92, including 12 for the R. Neth. A.F. Four production versions have appeared, known as the Series 100 and 200 40/48-seat passenger transports (Dart 511 and 528 respectively) and the Series 300 and 400 freighters (Dart 511 and 528 respectively). Late in 1960 Fokker announced a high-density version of the Series 100 and 200, seating 52 passengers at 30-in. pitch and having a new "inward opening, outward moving" passenger door. Certification of the Series 100 and 300 at 39,000 lb., and of the Series 200 and 400 at 42,000 lb., will be completed by mid-1961, bringing considerable payload-range benefits to F-27 operators.

Long-fuselage variants have been projected to seat up to 60/64 passengers. The length increases by 88.5 in. and Dart R.Da.7/2 or R.Da.10 engines would be used. Fokker is also now flying a STOL version of the F-27, with double-slotted flaps of the type originally fitted to the prototype Friendship, coupled with a variable-incidence stabilizer and, primarily for military applications, low-pressure tyres and rear-loading facilities.

GRUMMAN 159 GULFSTREAM. With more than 50 sold exclusively to corporate owners, the 10/12-seat Gulfstream has proved the most successful, to date, of turbine-powered executive transports. It was designed specifically for the business market. Slipper tanks are available if desired to extend the already-considerable range on internal tankage, and Dart R.Da.10s can be used to take advantage of the airframe strength—the original stressing was for 373 knots. Grumman also recently began a campaign to sell a version of the Gulfstream, the L159-2, to the U.S.A.F. as a 24-seat C-47 replacement for air evacuation, facilities inspection and high-priority personnel and cargo transport. The General Electric T64 is being offered as an alternative to the Dart in this version.

Lockheed JetStar (Pratt & Whitney JT12A-1).

Commercial Aircraft . . . .

HAMBURGER HFB 314. Work on this rear-engined (RB141) short-haul project was abandoned at the end of 1960 in the absence of financial backing from the West German Government and because of the superior competitive position of the D.H. Trident and Boeing 727.

HANDLEY PAGE HPR.7 HERALD. Scheduled service operations by a Herald are to begin next month by Jersey Airlines, and will be the culmination of eight years of private-venture development of this feederliner at a cost of more than £3 million. The original piston-engined Herald (HPR.3) was abandoned in favour of the present twin-Dart version in May, 1957, and two prototypes and a production model have been extensively tested and demonstrated since the first flight with Darts on Mar. 11, 1958.

Coupled with the announcement of Jersey Airlines' order for six Heralds in September, 1960, was news of a new version, the Series 200, with a 42-in. fuselage extension increasing the maximum seating from 48 to 56. Other Herald variants have been projected with Dart R.Da.10s, gross weight increased to 44,000 lb. and, for military customers, rear-loading doors and a STOL performance. The HPR.8 was a freighter and vehicle ferry project based on the Herald wing with a new fuselage able to seat more than 100 passengers and having optional nose-loading doors.

HANDLEY PAGE HP.117. A model of this large all-wing airliner was shown at the 1960 S.B.A.C. Display as an example of the company's studies into the application of boundary layer control. With suction slots to laminarize the wing, the 300-seat HP.117 would make possible, it is claimed, a D.O.C. of £5 10s. per seat between London and New York.

HEINKEL HE 211. This project for a short-haul transport was selected for further development in a Government-sponsored design contest in West Germany. It had a shoulder-wing and two Lycoming T55 turboprops, with accommodation for about 20 passengers. An alternative variant, the He 211B, was reported early in 1961 to have three General Electric CJ610 turbofans, presumably in the rear fuselage.

ILYUSHIN IL-18. In the past year the Il-18 has consolidated its position as the most successful of the Russian turbine transports and the only one exported in significant quantities. All the exports have been to Eastern Bloc countries or to newly-independent African states and may not, therefore, represent completely unbiased selection of the Il-18 on technical merit; nevertheless, the aircraft compares well with its Western contemporaries (Vanguard and Electra) and the Lenin prize awarded to its design team in 1960 was well deserved.

An English-language sales brochure on the Il-18 produced by Avtoexport in Moscow illustrates various possible layouts, and describes the 73/84-seat Il-18B as the most used. A high-density 120-seat (six-abreast) version has been designed, but requires an extension aft of the pressure shell; an executive interior is also illustrated. Among some notable Il-18 flights was the lifting of a 20-tonne (44,092 lb.) load to 39,370 ft.; a 9,260-naut. mile circuit from Moscow via Irkutsk, Petropavlovsk, the North Pole-6 drifting station, and Tiksi at 337 knots; and a three-sector flight from Moscow to Mexico in 21 hr. 5 min. elapsed time.

ISRAEL B101C. One of the first indigenous projects of Israel Aircraft Industries in Tel Aviv is for a small twin-jet executive, with a low, slightly-swept wing and two rear-mounted General Electric CJ610-2B turbofans. The two-pilot-plus-seven-passenger B101C could be available in 1963 and production of two prototypes is planned at present. To sell at about $300,000, the B101C has a gross weight of about 12,000 lb., a cruising speed of 469 knots at 30,000 ft. and a range of 1,750 naut. miles.

LOCKHEED L-188C ELECTRA. Sales of the Electra, as an immediately available medium-range turboprop transport, are still being sought by Lockheed, which has virtually completed production of the 168 sold to date. Meanwhile, LEAP (the Lockheed Electra Action Programme) is in full swing to modify all existing Electras in the light of the investigation into the cause of accidents to the Electra in 1959 and 1960. Two accidents, which caused the F.A.A. to impose speed restrictions on the Electra on Mar. 17, 1960, were found to have been caused by an undamped whirl mode in damaged powerplants. A modification scheme was designed to introduce extensive reskinning of the wing and general strengthening of the wing structure and engine mountings. A modified Electra flew in October, 1960, and the F.A.A. raised the speed restriction on Jan. 5, 1961. The first modified Electra was back in service with Eastern Airlines on Feb. 24 and the modification of all 168 aircraft is expected to be complete by mid-1961.

LOCKHEED 1329 JETSTAR. Type certification for the JetStar—the first pure jet executive transport—is imminent at the end of a test programme involving a prototype and the first five production aircraft. The latter have been used respectively for testing structural stability, control and flutter; performance; systems; engines; and function and reliability. Aircraft number seven is being furnished for a demonstration tour. Lockheed has orders for 26 executive JetStars and 13 for the U.S.A.F. and U.S.N. and hopes to sell many more to recover the $30.5 million written off against its development up to mid-1960. Initially the JetStar was designed to military requirements, and the first of two prototypes with twin-Orpheus powerplants flew on Sept. 4, 1957. Four P. & W. JT12As were selected as production powerplant in January, 1959, and a re-engined prototype flew in February, 1960. Fully equipped price of the 10-seat JetStar is approximately $1.35 million.

LOCKHEED C-141 SUPER HERCULES. A product of the company's Georgia Division, this project was named winner on Mar. 13, 1961, of a U.S.A.F. design competition for a MATS jet freighter. The MATS requirement is said to be for 132 initially, with some $1,000 million allocated for development and production. The first aircraft of the type are expected in service by the end of 1964, and a commercial freighter variant might conceivably be available by 1965. Although wholly financed by the U.S.A.F., the SOR 182 requirement was written in consultation with the F.A.A. to cover airline needs as far as possible, and the F.A.A. also participated in selection of the design for production.

The C-141 has a high wing with podded 21,000-lb. Pratt & Whitney JT3D-8A turbofans. Cruising speed will be 440-500 knots, and the key points on the payload-range curve are 60,000 lb. for 3,000 naut. miles and 20,000 lb. for 5,500 naut. miles. Maximum-weight field length has been specified at 6,000 ft. The gross weight is expected to be about 315,000 lb. Fuselage hold cross section will be 9 ft. 6 in. by 9 ft., with rear-loading; span is 160 ft. and length, 150 ft. (See our issue for Mar. 23, p. 309.)

MAX HOLSTE SUPER BROUSSARD. This light general-purpose turboprop transport is now being developed jointly by the designers, Avions Max Holste, and by the state-owned Nord Aviation. In the terms of an agreement concluded on Nov. 23, 1960, Nord is responsible for production while Max Holste continues with design and flight development. The latter began, with the Twin Wasp-powered MH250, on May 20, 1959; the definitive prototype of the MH260 flew on Jly. 29, 1960, with two Bastan IIIA turboprops. These were replaced in October by

(Continued on page 411)

Above, Max Holste Super Broussard (Turbomeca Bastan).

Left, Ilyushin Il-18 (Ivchenko AI-20)

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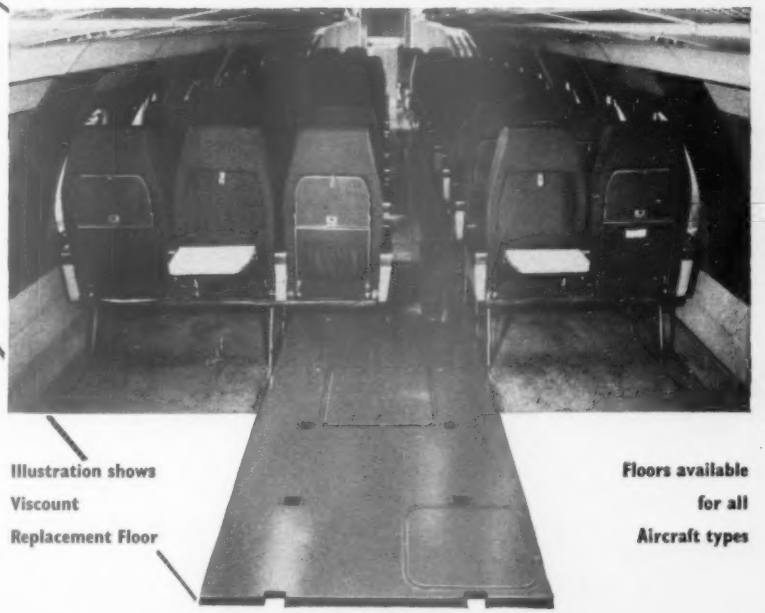

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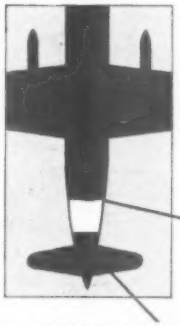

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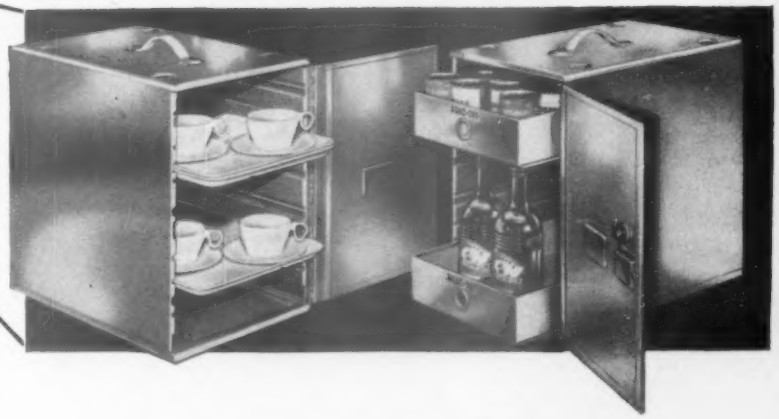

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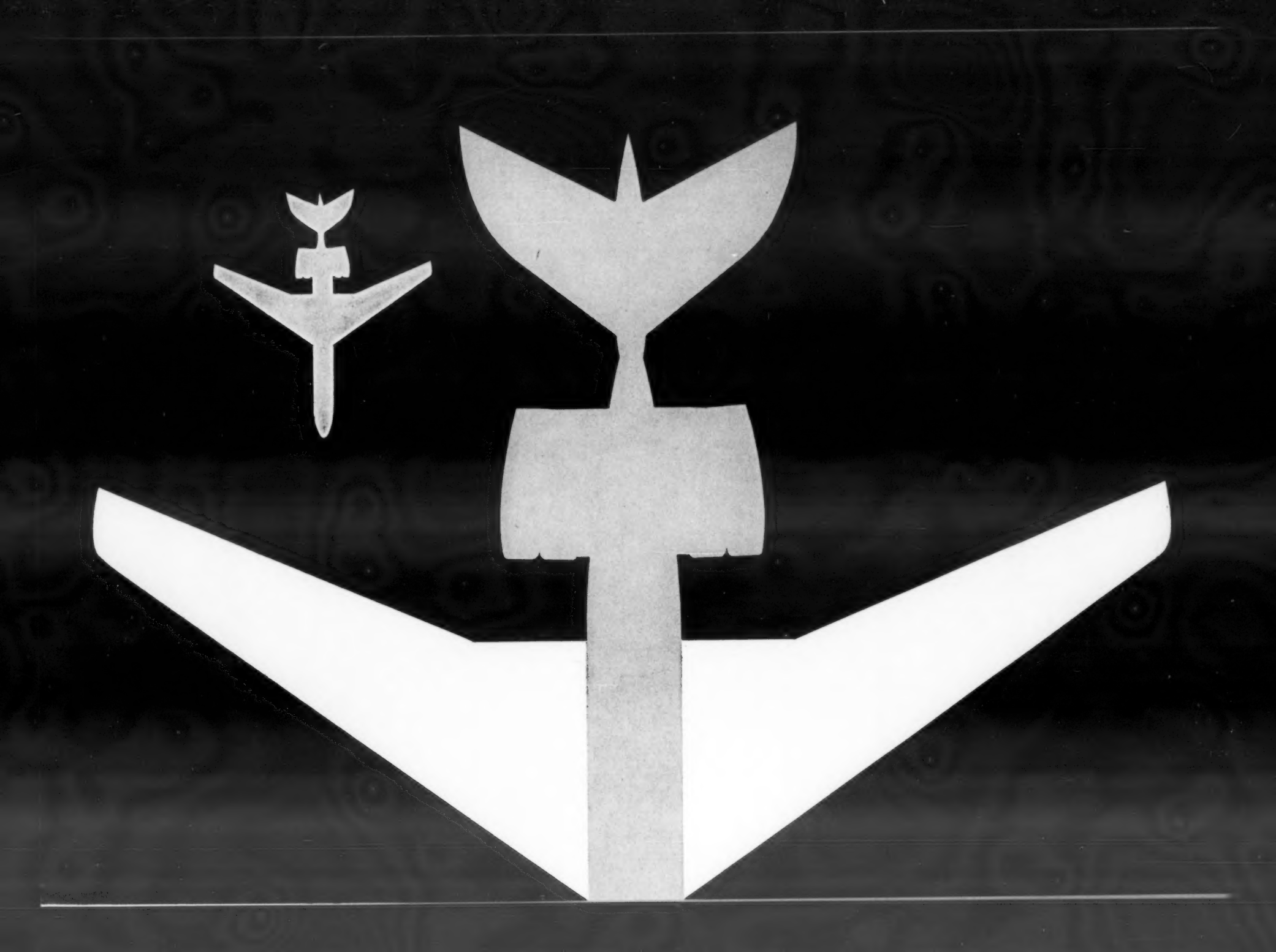

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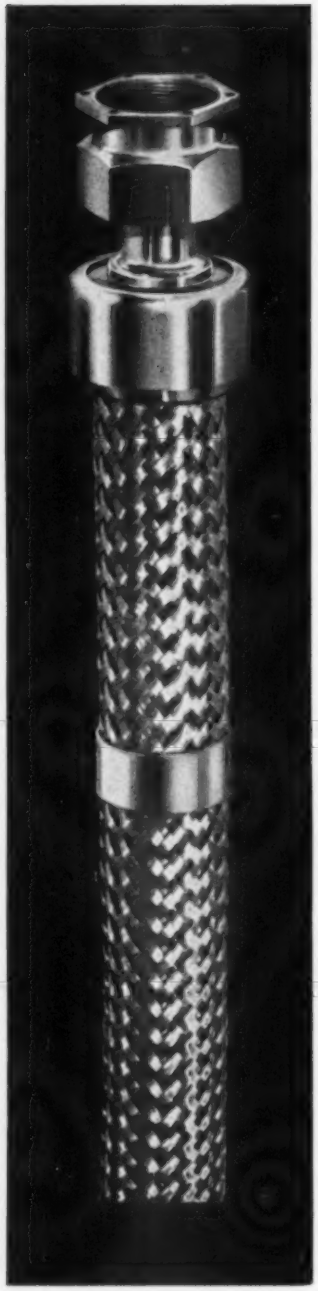

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PAL 16A

Commercial Aircraft . . . .

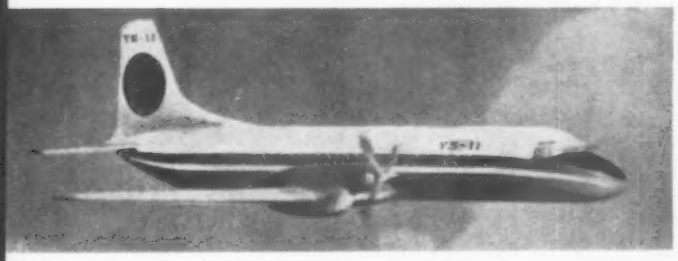
(*Continued from page 410*)

986 h.p. Bastan IVs with bigger propellers, and 1,000 e.h.p. Bastan Vs will be fitted shortly. The first production 20/23-seat Super Broussard is to fly in the autumn of 1961 and will be used for certification trials. Production deliveries are to begin in 1962 with 17 aircraft scheduled for completion by the end of the year. A number of options are reported to have been placed for Super Broussards.

Plans have recently been finalized for development of the MH262, a version with a circular-section, pressurized fuselage. A military version of the Super Broussard has been designed to the current French Air Force requirement for a light transport.

McDONNELL 220. McDonnell built a private-venture light jet transport to meet the U.S.A.F. "UCX" requirement, in competition with the Lockheed JetStar; this flew as the McDonnell 119 on Feb. 11, 1959, with four 3,000-lb. Westinghouse J34 turbojets. An executive 10-seat transport variant of the same design, with P. & W. JT12 turbojets, has been projected as the McDonnell 220, and the prototype has been refurnished and restyled in this guise. No decision has yet been taken to market this aircraft.

NAMCO YS-11. Development of an indigenous turboprop transport began in Japan in 1957 and is now being conducted by the Nihon Aeroplane Manufacturing Co., in which the Japanese Government is represented together with six major aircraft manufacturers. These companies, which are sharing the task of design and construction, are Mitsubishi, Kawasaki, Fuji, Shin Meiwa, Nihon Hikoki and Showa Hikoki. Contracts so far cover construction of four prototypes (two for static and fatigue tests); the first YS-11 is to fly at the end of this year. Particular emphasis has been placed upon good field performance for the 52/60-seat YS-11, which is intended initially for domestic services in Japan. Interest in the YS-11 has also been expressed by the Japanese National Defence Agency as a C-46 replacement and by other Government agencies. Tentative production plans are for five in 1963, 10 in 1964, 18 in 1965 and two a month thereafter. (See our issue for Nov. 4, 1960.)



Namco YS-11 (Rolls-Royce Dart).

NORTH AMERICAN SABRELINER. A recent decision has been made to proceed with F.A.A. certification of the 6/9-seat twin-jet Sabreliner for business and executive use. The design was originally undertaken to meet a U.S.A.F. requirement for a utility jet trainer/transport, and a total of 94 have been ordered to date under the military designation T-39. Certification of the Sabreliner with two 3,000-lb. P. & W. JT12A-6 rear-mounted turbojets is expected by May. The Sabreliner characteristics include the following: span, 44 ft. 5 in.; length, 43 ft. 9 in.; wing area, 342 sq. ft.; cabin volume, 230 cu. ft.; gross weight, 17,760 lb.; best-cost cruising speed, 370 knots at 35,000 ft. at 14,500 lb.; field length required (SR422B), 5,000 ft. in I.S.A. at sea level; range with full tanks, 1,810 naut. miles at 413 knots at 44,000 ft.

Lockheed C-141 Super Hercules (Pratt & Whitney JT3D-8A).

Potez 840 (Turbomeca Astazou).

PIAGGIO DC-108. A turboprop or turbofan executive aircraft is reported to have been developed jointly by Piaggio and Douglas, and is ready for construction if the Italian Government will share development costs with Piaggio. One proposed design is reported to be similar to the Piaggio P.166, with 400 h.p. P. & W. PT6 turboprops.

POTEZ 840. One of the smallest turbine transports built to date, the Potez 840 is a "baby airliner" in the fullest sense, with a well-equipped pressurized cabin for 16 passengers (or 24 high density). Two prototypes have been built as a private venture, the first of these having just started its flight trials at Toulouse. The design was begun in May, 1959, and construction started early in 1960. (See our issue for Mar. 23, 1961.)

SAAC 23. Designs for a twin-jet executive have been completed by the Swiss American Aviation Corp., founded by William P. Lear, Sen., and the first of two Swiss-built prototypes is planned to fly next year. The SAAC 23 will have a slightly swept low wing and two turbofans (probably General Electric CJ610-2Bs) and will seat two pilots and eight passengers. Unequipped cost of production models, which would be built in Europe and shipped to the U.S. less engines, instruments and furnishing, would be about $250,000. Production deliveries could begin early in 1963. Gross weight is about 12,000 lb.; span, 34 ft. 5½ in.; length, 37 ft. 7 in.; cruising speed, 455 knots at 30,000 ft. and range more than 1,900 naut. miles with two permanent wing-tip fuel tanks.

Short Belfast (Rolls-Royce Tyne).

SHORT BELFAST. Civil freighter versions of this specialized strategic transport for the R.A.F. (previously named the Britannic) will be offered in due course for service by 1965/66. By this time, the makers anticipate, freight traffic will have developed to the point where a small fleet of Belfasts could be exclusively employed on commercial operation.

An initial R.A.F. order for 10 Belfasts was confirmed earlier this year, on a fixed-price basis, and a £5-million loan has been obtained from the Northern Ireland Government to finance Belfast development. Short Bros. and Harland plans are based on the sale of not less than 30 Belfasts, including civil models. The first for the R.A.F. is to fly in the first half of 1962.

SIPA 272 PRESENCE. A series of design studies (75,000 man-hours in 1960) has been made by SIPA under the name of Presence for a light twin-turboprop freighter and business aircraft. The latest of these designs, the S.272, is for a low-wing aeroplane with a pressurized circular-section, swing-nose fuselage and two Astazou engines on the wing. With Caravelle-type seats the Presence seats 12 passengers: as a pressurized freighter, a car or Jeep can be accommodated. Greater payloads can be carried by unpressurized versions. Data for the S.272, which is also being offered to the French Air Force, will be found on pages 404-406.

Commercial Aircraft . . . .

SUD AVIATION CARAVELLE. Orders for 34 Caravelles in the past year have made this one of the most successful jet transports; the total of 116 now sold to airlines is exceeded only by the Boeing 707 and Douglas DC-8 sales, although it is still 104 short of the reported break-even figure. First flown on May 27, 1955, the Caravelle was the first of the rear-engined transports, and was originally designed with a triple-Avar installation in a layout similar to that now adopted for the Trident and Boeing 727.

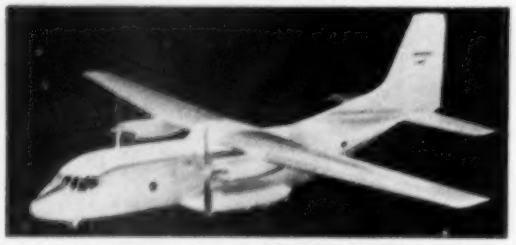
Production of the 72/80-seat Caravelle I and IA is complete. These had, respectively, Avon 522 and Avon 526 engines. The Caravelle III has the more powerful Avon 527 and structural strengthening for the higher gross weight of 101,400 lb. Sud completed the 19th production Caravelle as a privately financed prototype for the III and later variants, and the first production III was delivered to Alitalia on Apr. 29, 1960.

A further important development stage was reached on Sept. 16, 1960, when Caravelle No. 19 flew as the prototype VI, re-equipped with Avon 531s. Certification was obtained after 352 hours of flight testing at the increased gross weight of 105,820 lb. The first production Caravelle VI (No. 64) flew on Jan. 17, 1961, and was delivered to Sabena on Jan. 20, entering service on Feb. 18. On Feb. 6, Sud flew the first Caravelle VI R (No. 62), destined eventually for United Airlines. In the VI R, Avon 533Rs with thrust reversers allow a further weight increase to 110,230 lb.

On Jly. 25, 1960, the Caravelle III No. 42 was delivered to General Electric in New York and, following a five-week demonstration tour, was re-engined with 16,100-lb. CJ805-23C turbofans. In this form it flew on Dec. 29, 1960. A version with these engines is being offered as the Caravelle VII, with a small fuselage extension and gross weight increased to 114,640 lb. Also projected is the Caravelle X, with P. & W. JT8D-1 turbofans, the original fuselage length, and a gross weight of 113,540 lb.

Sud Aviation have dropped development of the Caravelle VIII, which was to have been similar to the VII but with RR.141-3 engines, and of the joint Sud-Douglas Caravelle XIV, which was to have had 15,000-lb. RR.141-11A engines and a Douglas-designed wing.

SUD AVIATION CARAVELLE JUNIOR. Variously referred to as the B6bd-Caravelle and Micro-Caravelle, this project is for a 40/50-seat short-fuselage variant, possibly having P. & W. JTF10 turbofans.

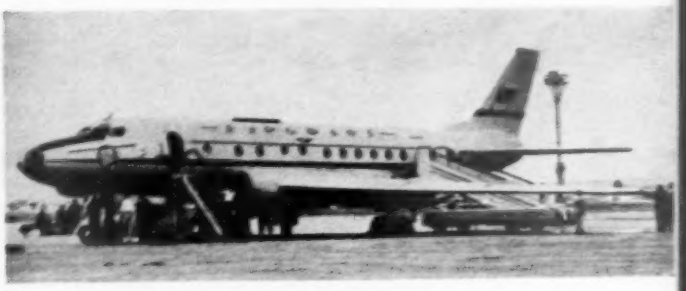


Transall C.160 (Rolls-Royce Tyne).

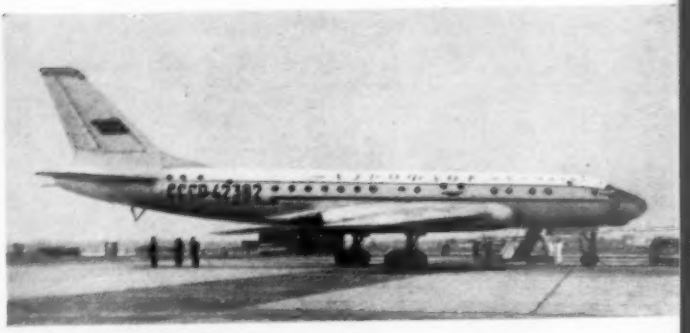
TRANSALL C.160. A civil version is planned of this joint Franco-German design for a military freighter, powered by two R.-R. Tyne RTy.20 turboprops. Participating in the Transall Alliance (Arbeitsgemeinschaft Transall) are Nord-Aviation in France, and Hamburger, Blume and Weser in Western Germany. Nord will build and fly the first C.160 prototype. In layout resembling the Lockheed Hercules, the C.160 has a cabin 42 ft. 8 in. long and 10 ft. 4 in. by 9 ft. 9 in. in cross section; total volume is 4,837 cu. ft. Other characteristics of the initial military version are: span, 131 ft. 3 in.; length, 102 ft.; wing area, 1,722 sq. ft.; max. payload, 26,445 lb.; gross weight, 90,390 lb.; cruising speed, 270 knots at 26,250 ft.; range with 17,640-lb. payload, 2,430 naut. miles.

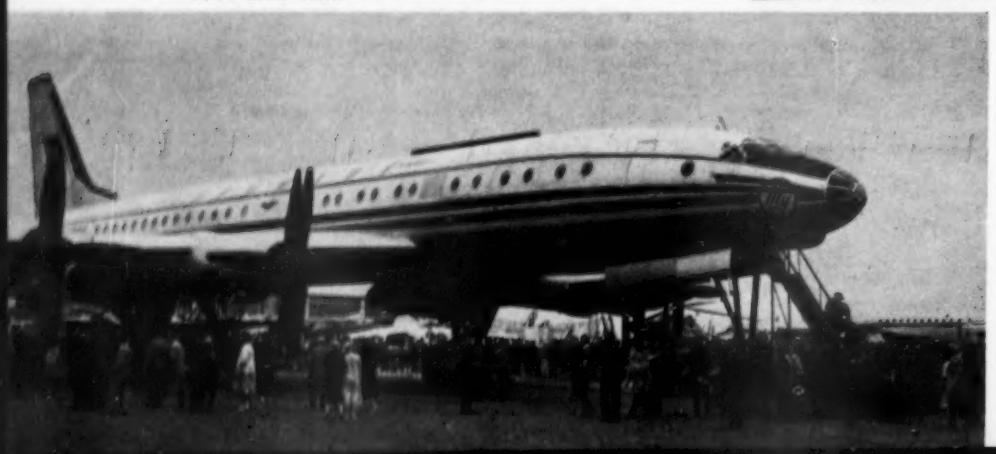
Sud Aviation Caravelle VI (Rolls-Royce Avon).

TUPOLEV TU-104. Russia's first—and the World's second—turbojet airliner in service, the Tu-104 is used by Aeroflot in three versions. The original 50-seat Tu-104 was followed by the 70-seat Tu-104A, which is the principal version in Aeroflot international services, and the high-density 100-seat Tu-104B, used domestically. A version called the Tu-104E established F.A.I. records in April, 1960, by carrying a 33,070-lb. payload over a 2,000-km. circuit at 596.5 m.p.h.; this variant was recently reported to have Soloviev turbofan engines, but is not known to be in service.



Tupolev Tu-124 (Soloviev turbofan).





Above, Tupolev Tu-104 (Mikulin AM-3M).

Left, Tupolev Tu-114 (Kuznetsov NK-12M).

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Vickers Viscount 806 (Rolls-Royce Dart).

Vickers VC10 (Rolls-Royce Conway).

Commercial Aircraft . . . .

SUD AVIATION CARAVELLE. Orders for 34 Caravelles in the past year have made this one of the most successful jet transports; the total of 116 now sold to airlines is exceeded only by the Boeing 707 and Douglas DC-8 sales, although it is still 104 short of the reported break-even figure. First flown on May 27, 1955, the Caravelle was the first of the rear-engined transports, and was originally designed with a triple-Atar installation in a layout similar to that now adopted for the Trident and Boeing 727.

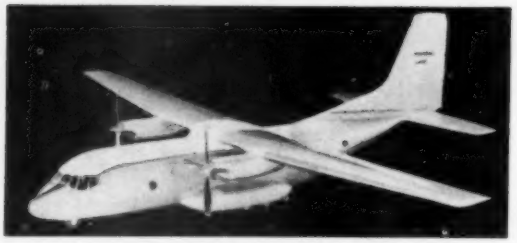
Production of the 72/80-seat Caravelle I and IA is complete. These had, respectively, Avon 522 and Avon 526 engines. The Caravelle III has the more powerful Avon 527 and structural strengthening for the higher gross weight of 10,400 lb. Sud completed the 19th production Caravelle as a privately financed prototype for the III and later variants, and the first production III was delivered to Alitalia on Apr. 29, 1960.

A further important development stage was reached on Sept. 10, 1960, when Caravelle No. 19 flew as the prototype VI, re-equipped with Avon 531s. Certification was obtained after 352 hours of flight testing at the increased gross weight of 105,820 lb. The first production Caravelle VI (No. 64) flew on Jan. 17, 1961, and was delivered to Sabena on Jan. 20, entering service on Feb. 18. On Feb. 6, Sud flew the first Caravelle VI R (No. 62), destined eventually for United Airlines. In the VI R, Avon 533Rs with thrust reversers allow a further weight increase to 110,230 lb.

On Jly. 25, 1960, the Caravelle III No. 42 was delivered to General Electric in New York and, following a five-week demonstration tour, was re-engined with 16,100-lb. CJ805-23C turbofans. In this form it flew on Dec. 29, 1960. A version with these engines is being offered as the Caravelle VII, with a small fuselage extension and gross weight increased to 114,640 lb. Also projected is the Caravelle X, with P. & W. JT8D-1 turbofans, the original fuselage length, and a gross weight of 113,540 lb.

Sud Aviation have dropped development of the Caravelle VIII, which was to have been similar to the VII but with RB.141-3 engines, and of the joint Sud-Douglas Caravelle XIV, which was to have had 15,000-lb. RB.141-11A engines and a Douglas-designed wing.

SUD AVIATION CARAVELLE JUNIOR. Variously referred to as the Bébé-Caravelle and Micro-Caravelle, this project is for a 40/50-seat short-fuselage variant, possibly having P. & W. JTF10 turbofans.



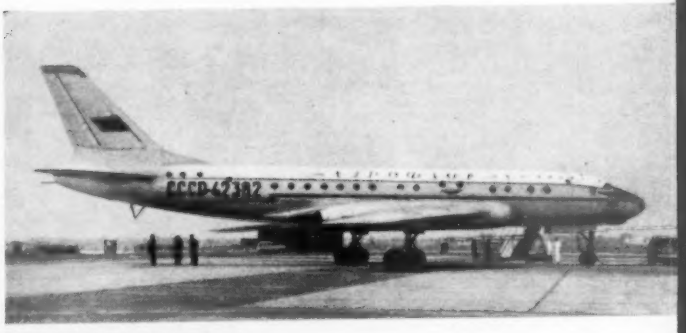
Transall C.160 (Rolls-Royce Tyne).

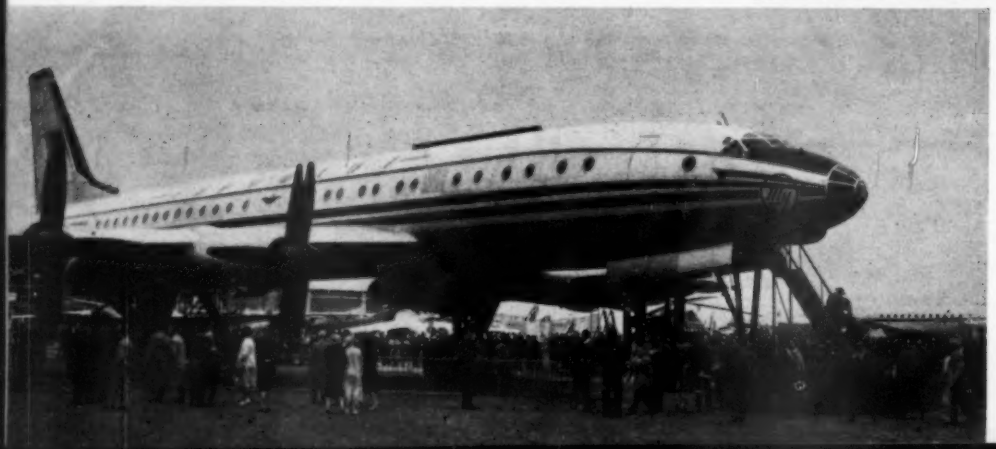
TRANSALL C.160. A civil version is planned of this joint Franco-German design for a military freighter, powered by two R.-R. Tyne RTy.20 turboprops. Participating in the Transall Alliance (Arbeitsgemeinschaft Transall) are Nord-Aviation in France, and Hamburger, Blume and Weser in Western Germany. Nord will build and fly the first C.160 prototype. In layout resembling the Lockheed Hercules, the C.160 has a cabin 42 ft. 8 in. long and 10 ft. 4 in. by 9 ft. 9 in. in cross section; total volume is 4,837 cu. ft. Other characteristics of the initial military version are: span, 131 ft. 3 in.; length, 102 ft.; wing area, 1,722 sq. ft.; max. payload, 26,445 lb.; gross weight, 90,390 lb.; cruising speed, 270 knots at 26,250 ft.; range with 17,640-lb. payload, 2,430 naut. miles.

Sud Aviation Caravelle VI (Rolls-Royce Avon).

TUPOLEV TU-104. Russia's first—and the World's second—turbojet airliner in service, the Tu-104 is used by Aeroflot in three versions. The original 50-seat Tu-104 was followed by the 70-seat Tu-104A, which is the principal version in Aeroflot international services, and the high-density 100-seat Tu-104B, used domestically. A version called the Tu-104E established F.A.I. records in April, 1960, by carrying a 33,070-lb. payload over a 2,000-km. circuit at 596.5 m.p.h.; this variant was recently reported to have Soloviev turbofan engines, but is not known to be in service.

Tupolev Tu-124 (Soloviev turbofan).





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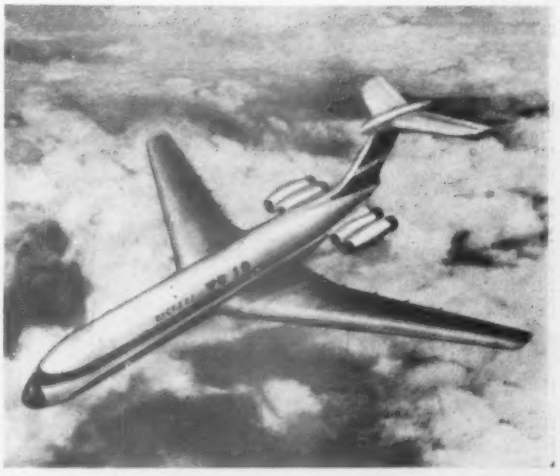

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Commercial Aircraft . . . .

SUPERSONIC PROJECTS

BOEING MODEL 733. This number covers one of several design studies made by Boeing for a supersonic transport. Much interest is being shown in a variable-geometry arrangement, but a 733 variant (page 395) shows a canard delta with four under-wing pods. Both light alloy (for Mach 2.0) and steel (for Mach 2.5-3.0) structures are being studied; the company favours the latter speed if a cost-breakthrough in steel structures can be achieved. (See our issue for Nov. 25, 1960, pp. 704-705.)

BRISTOL (B.A.C.) 198. This Bristol design is understood to be the basis of British Aircraft Corporation's supersonic project for which a £350,000 design study contract was placed in October, 1960. No official information on the Bristol 198 has been released, but the B.A.C. design selected by the Ministry of Aviation for further development is believed to be a light-alloy Mach 2.2 type with a narrow delta wing, probably seating 100 or so passengers and designed for transatlantic operation. As part of a general investigation into narrow delta and ogee wings initiated by the now defunct Supersonic Transport Aircraft Committee, the low-speed Handley Page H.P. 115 has been built and Bristol are to convert a Fairey FD-2 for high-speed tests.

CONVAIR B-58 TRANSPORT. As a means of obtaining supersonic transport experience as quickly and cheaply as possible, Convair made detailed proposals towards the end of 1960 for a transport version of the B-58 Hustler supersonic bomber, using the existing wing structure, vertical tail and landing gear, with a new fuselage and powerplants. At a gross weight of 190,000 lb., this Convair model 58-9 would carry 52 passengers two-abreast for 2,500 naut. miles at Mach 2.4, with a D.O.C. of 2.5 cents/seat-mile.

Convair has laid down a schedule whereby a prototype B-58 transport could fly 33 months from the go-ahead. Manufacturer's tests with four aeroplanes would occupy 18 months, after which Government agencies could fly the aeroplanes, and simulated airline operations by MATS begin four years from go-ahead.

CONVAIR SST. Many supersonic transport designs have been studied by Convair. One, current early in 1960, cruised at Mach 3.0 with four turbojets and had a narrow delta wing, with fins at its tips, and a noseplane. Gross weight was 375,000 lb. and range 3,300 naut. miles at 65,000 ft.

HANDLEY PAGE H.P. 109. As part of continuing research into laminarization, this Mach 2.2 delta-wing transport was studied in 1960. With a gross weight of 310,000 lb., it has a 50% bigger payload and 39% lower D.O.C. than an unlaminarized aircraft of similar configuration.

LOCKHEED CL-408. This is a representative supersonic transport under study at Burbank during 1960. Intended for Mach 3.0 operations between 60,000 ft. and 70,000 ft., it is a slender delta, with variable anhedral on the wing tips, and paired turbojets at the trailing edge. Span-to-fuselage-length ratio is 1 : 2½, and the seating capacity up to 110, five-abreast. Lockheed believe the SST is potentially profitable, but the unit price could be as high as $25 million for small production runs.

NORD SST. An all-steel Mach 3 project with ramjet power is reported to have been drawn by Nord for the Government design competition which required tenders to be submitted by the end of 1960.

NORTH AMERICAN B-70 SST. Although the programme on the B-70 Valkyrie, which was recently increased from two prototypes to 12, is now likely to be cut back to four, this aircraft is still likely to be the first to provide real experience of Mach 3 flight with a larger aeroplane. Directly or indirectly, therefore, it is likely to influence the development of an SST in the U.S.A. Proposals have been made by North American for transport versions of the B-70. By 1966, an 80/106-seat transport could be available to carry a 75,000-lb. payload 2,470 naut. miles; with a bigger fuselage diameter than the B-70, it would have the same J93 engines. A year later, a fully commercialized transport could be offered, with J93 turbofan versions and modifications to permit FAA certification. This would have a D.O.C. of 2.5-2.75 cents/seat-mile carrying 90 passengers.

SUD-DASSAULT SST. Both Sud Aviation and Dassault have prepared separate project designs for submission to the Government in response to an outline requirement for a 60/80-seat supersonic transport to fly 1,800-2,000 naut. mile stages at Mach 2. If either of these designs is selected, it will be developed jointly by the two companies, probably under the name Super Caravelle.

COMMERCIAL HELICOPTERS

AGUSTA AZ-101. Under construction for the Italian Air Force, the 30-seat AZ-101 is a single-rotor helicopter of conventional design and possible commercial application. It is powered by three D.H. Gnome H1000 shaft turbines and has a gross weight of 24,000 lb.

BLACKBURN SP 60. Under this designation, Blackburn's project team has been studying a very large crane-type helicopter, in which a turbojet or turbofan engine is mounted vertically on each rotor blade, near its axis, to feed exhaust gas to rotor-tip ejectors. The engines rotate with the blades to avoid the necessity for rotating seals. Beneath this rotor system is suspended a chassis, control cabin and hoist. A wide variety of detachable pods and containers could be designed; one such, studied for Channel Air Bridge, could carry 18 cars and about 90 passengers for cross-Channel operation (see our issue for Mar. 17, 1961).

BOEING-VERTOL 107-II. Deliveries of this tandem-rotor 25-seat helicopter to New York Airways are about to start, following six months of test and certification flying. The design is derived from the Lycoming-engined Vertol 107 private-venture prototype by way of the three U.S. Army YHC-1As, one of which was converted to 107-II configuration for trials beginning on Oct. 24, 1960. NYA has ordered five with an option on five more, and Fuji Air Transport has ordered two of the 10 recently purchased by Kawasaki Aircraft.

Sikorsky S-61L (General Electric CT58-100).

SIKORSKY S-61L. First flown on Dec. 6, 1960, the first S-61L has now been joined by two more for certification testing, and deliveries are to be made to Los Angeles Airways (five ordered) and Chicago Helicopter Airways (four ordered) later this year. The 25/28-seat S-61L is the first multi-engine Sikorsky helicopter for airline use and is based on the rotor transmission system of the HSS-2, in production for the U.S. Navy. The hull of the S-61 can be sealed for amphibious operations, but this is not a feature of the S-61L variant at present in production.

SIKORSKY S-64. To fly later this year, the Sikorsky S-64 is an outgrowth of the S-60 flying-crane prototype, designed as a lifting unit to handle any type of externally slung load, including passenger pods. With two 6,400-s.h.p. Pratt & Whitney JFTD12A-1 turbines driving a 72-ft.-diameter, six-blade rotor, the S-64 will carry a 17,640-lb. payload for 43 naut. miles at 95 knots. The gross weight is 38,000 lb. Sikorsky is also developing larger cranes, of similar layout, for loads up to 80,000 lb.

Boeing-Vertol 107-II (General Electric CT58-100).

SUD AVIATION FRELON. For the French military services, Sud is developing the SA 3200 Frelon helicopter, powered by three 1,100-h.p. Turmo engines. Commercial versions have been proposed for 20-24 passengers. With a 49-ft. rotor, the Frelon grosses 16,520 lb. and carries a 4,400-lb. payload over 77 naut. miles range.

WESTLAND 194. This member of the Bristol tandem-rotor family of helicopters is available as an alternative to the Rotodyne for development as a commercial transport. Powered by four de Havilland Gnome H1200 shaft turbines, it has a 40-ft-span wing to give 50% of total lift in forward flight. Each six-blade rotor has a 55-ft. diameter and the fuselage is 77 ft. long.

WESTLAND WESSEX 2. With two D.H. Gnome free turbines in place of the Wessex 1's single Gazelle, the Wessex 2 is to fly this year and is of potential civil interest for taxi work and subsidized scheduled operations. At 13,500 lb. gross, it is the smallest twin-turbine helicopter so far on offer.

WESTLAND 192C. With two Napier Gazelle free turbines, the 23-seat 192C is a commercial version of the tandem-rotor Belvedere, and figures in the B.E.A. transport helicopter programme now awaiting Government approval. Up to 10 might be required for interim operations on local routes in the U.K., such as that from Heathrow to Gatwick.

WESTLAND ROTODYNE. A small amount of flying has been done on the Eland-engined prototype of the Rotodyne convertiplane during the past year, while design work on the definitive 70-seat Tyne-engined version has continued in the former Fairey design office at Hayes. The commercial future depends on Government policy towards the Rotodyne's noise level, in connection with which some trial flights into the London Heliport were made on Mar. 3. To date, Westland have obtained a £4m. Government development contract for the Rotodyne, and provisional orders from the R.A.F., B.E.A. and New York Airways. A £1.4m. Government grant towards the cost of introducing the Rotodyne into B.E.A. service has also been promised.

PISTON-ENGINED TRANSPORTS

AERO COMMANDER 680. Several airlines and taxi operators use this light twin, which is in production primarily for business and executive use. The 5/7-seat 680F, which at 8,000 lb. gross is the heaviest variant of the series, has supercharged engines and has established a class altitude record of 37,010 ft. The Model 720 Alti-Cruiser is similar but has a pressurized cabin.

AVIATION TRADERS ATL-98 CARVAIR. The first flight of this DC-4 conversion is expected at Southend next month, and certification by the end of the year will allow Channel Air Bridge to introduce the type on their vehicle ferry routes next year. Ten have been ordered by Channel Air Bridge, and Aviation Traders will finance three more initially. The Carvair conversion involves building on a new front fuselage, with flight deck, over the nose-loading doors, re-routeing control runs and increasing fin and rudder area. With a capacity for five cars and 25 passengers, the Carvair offers a new lease of life for DC-4s—a fact which is underlined by the first conversion having already flown 37,000 hr. as an ordinary DC-4. Operating costs are claimed to be substantially better than those of the Bristol 170.

BEECH/SFERMA 18S. Several airlines have obtained long and useful service from models of the nine-seat Beechcraft 18, which first appeared in 1937 and has been in production ever since, some 7,000 having been built. The latest commercial variant, for business and feederline use, is the Super G18S, which is also offered with standby rocket power consisting of an Aerojet-General Junior Jet in each nacelle to add 200 h.p. for 15 seconds.

In France, SFERMA has converted three Beech 18S twins to have Turbomeca Bastan turboprops. The first of these PD18S versions flew on Sept. 18, 1958, and the third, with greater fuel capacity, is now being used for type certification. With a gross weight of 11,000 lb., the PD18S cruises at 230 m.p.h. and has an initial climb rate of 1,970 ft./min.

DE HAVILLAND D.H.104 DOVE. Production of this 5/6-seat feederliner and business twin has been continuous since 1945—the first Dove flew on Sept. 25 in that year—and 50 or so, of more than 500 built, are used by airlines around the World. Latest variant is the Dove 8 or the Dove Custom 800, which has ejector exhausts on the Gipsy Queen 70s, a Heron-type cockpit canopy and higher gross weight, and is intended primarily for the executive market.

DE HAVILLAND D.H.114 HERON. About half the 150 Herons built since the first flight on May 10, 1950, are in airline service, the remainder being used as executive transports. The 14/17-seat Heron has been built as Series 1 with fixed u/c and Series 2 with retractable u/c. Vest Aircraft de Mexico has developed a Super Heron with four 340-h.p. Lycoming GSO-480 engines for better performance at high-altitude, high-temperature airports.

DE HAVILLAND DHC.4 CARIBOU. Production of this STOL transport is at present concentrated on military versions, principally for the U.S. Army. With its rear-loading facilities and excellent take-off properties from unprepared surfaces, it has potential commercial applications in undeveloped areas. The prototype first flew on Jly. 30, 1958, and one Caribou is at present being completed with General Electric T64 turboprops.

Piaggio P.166 (Lycoming GSO-480).

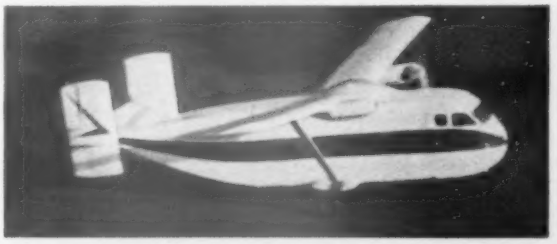
DORNIER Do P.346. A three-engined development of the Dornier Do 27/28 series of STOL aircraft has been projected as a light transport for 10-12 passengers. The arrangement of the 365-h.p. Lycoming engines would be similar to that in the Do 28, with the third engine in the nose; a triple tail unit and a fixed tricycle undercarriage would be featured. Project 346 would have a gross weight of 11,020 lb., a cruising speed of 124 knots, and STOL performance using high-lift devices on the wing.

PIAGGIO P.166. Designed primarily for the executive market, the 6/9-seat P.166 is also in use as a feederliner with several airlines, among them Papuan Air Transport (Patair), Deutsche Taxiflug, Agip Mineraria and Mandated Airlines. The P.166 first flew on Nov. 26, 1957, and production deliveries began in April, 1959; approximately 50 have been ordered to date and the type is marketed in the U.S. by Trecker Aircraft and known as the Royal Gull.

SCOTTISH AVIATION TWIN PIONEER. Recent orders for this STOL 13/16-seat twin-engined airliner bring the total to about 100, of which a half are in airline or business use. Airline users include de Kroonduif, Borneo Airways, Philippine Air Lines, and, most recently, Sierra Leone Airways. Present production version is the Series 3 with 600-h.p. Leonides 531/8 engines in place of the 500-h.p. Leonides 514/8s in the Series 1. Philippine Air Lines' Series 2s have 600-h.p. P. & W. Wasp R-1340-S3H1-G radials.

SHORT SKYVAN. Development of this light freighter is being undertaken by the Light Aircraft Division of the company, which is building two prototypes as a private venture. The first is to fly this summer, and production aircraft are offered from June, 1962. The design is based on that of the Miles (Hurel Dubois) HDM 106, which was further developed by Short Bros. and named the Skyvan in August, 1960. Although one of the lightest "twins" available for commercial operations, the Skyvan has a 3,000-lb. payload and unrestricted rear-loading into the 16-ft.-long, 6½-ft.-square hold. Its Continental engines will be built by Rolls-Royce and a typical equipped price will be £55,000 with development costs spread over 100 units.

Aviation Traders Carvair (P. & W. R-2000-7M).

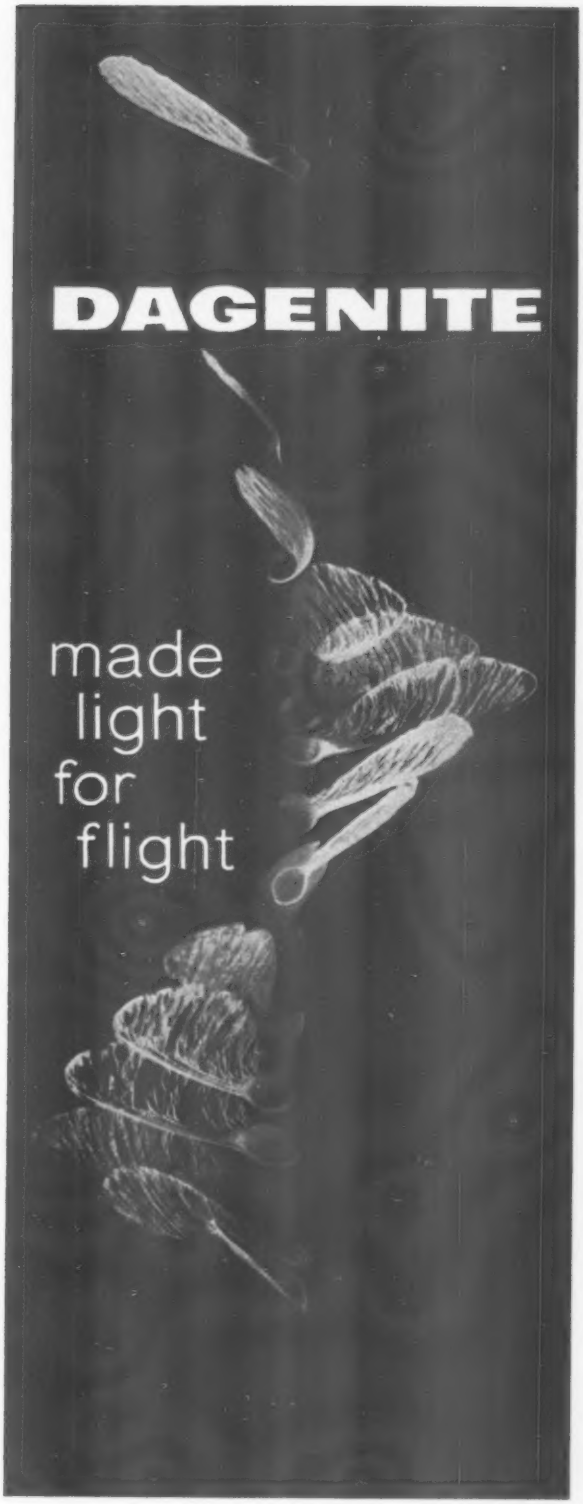


Short Skyvan (Continental GTS-IO-520).

Commercial Gas Turbine Engines

Engines: Make and name	Type	Compressor: Type	Stages	Pressure ratio	Air mass flow	No. of combustion chambers	No. of turbine stages	Sea-level static performance: Take-off: lb. th.	s.h.p.	e.h.p.	r.p.m.	lb./*/hr.	Maximum continuous: lb. th.	s.h.p.	r.p.m.	lb./*/hr.	Overall dimensions: Length of engine	Length with ex-cone	Width or height	Dry weight	Power/weight ratio
					lb./sec.			lb. th.	s.h.p.	e.h.p.	r.p.m.	lb./*/hr.	lb. th.	s.h.p.	r.p.m.	lb./*/hr.	in.	in.	in.	lb.	*/lb. wt.
FRANCE																					
Turbomeca																					
Astazou II	Tp.	Ax.+C.	1+1	5.7 : 1	N.A.	Ann.	3	N.A.	523	554	40-43,000	0.594	N.A.	503*a*	40-43,000	0.609	69.0	N.A.	18.4	440*p*	N.A.
Bastan IV	Tp.	Ax.+C.	1+1	N.A.	N.A.	Ann.	3	N.A.	930	1,000	33,500	0.602	N.A.	865*a*	33,500	N.A.	60.9	N.A.	21.6	N.A.	N.A.
Turmo IIIB	S.T.	Ax.+C.	1+1	5.65 : 1	N.A.	Ann.	2×1	N.A.	790	N.A.	34,050	0.67	N.A.	632	N.A.	0.769	66.0	N.A.	29.4	440	N.A.
UNITED KINGDOM																					
Bristol Siddeley																					
BS 75	Tf.	Ax. × Ax.	3×10	13.0 : 1	N.A.	Cann.	2×2	7,350	—	—	N.A.	0.508	N.A.	—	N.A.	N.A.	89.0	N.A.	33.4	1,485	4.95
Proteus 765	Tp.	Ax.+C.	12+1	7.2 : 1	44.3	8	2×2	1,260	3,915	4,400	11,593	0.593	1,155	3,480	11,500	0.607	N.A.	100.6	40.1	2,900	1.52
Napier																					
Eland 504A	Tp.	Ax.	10	7.0 : 1	33.5	6	3	700	3,230	3,500	12,500	0.608	625	2,670	12,000	0.63	95.5	116.0	36.0	1,820	1.92
Rolls-Royce																					
Avon RA.29/1	Tj.	Ax.	16	9.1 : 1	173.0	Cann. 8	3	10,500	—	—	8,050	0.77	9,125	—	7,650	0.739	N.A.	126.0	39.0	3,308	3.18
Avon RA.29/3	Tj.	Ax.	16	9.35 : 1	173.0	Cann. 8	3	11,400	—	—	8,050	0.805	9,500	—	7,750	0.748	N.A.	126.0	39.0	3,327	3.42
Avon RA.29/6	Tj.	Ax.	17	10.06 : 1	185.0	Cann. 8	3	12,200	—	—	8,050	0.762	10,820	—	7,850	0.724	N.A.	134.0	39.0	3,491	3.52
Conway RCo.12	B.P.	Ax. × Ax.	7×9	14.1 : 1	281.0	Cann. 10	1×2	17,500	—	—	9,980	0.725	14,625	—	9,590	0.69	N.A.	136.0	42.0	4,544	3.86
Conway RCo.15	B.P.	Ax. × Ax.	7×9	*14.3 : 1*	*295.0*	Cann. 10	1×2	18,500	—	—	*9,895*	*0.701*	15,000	—	*9,500*	*0.667*	N.A.	136.0	42.0	*4,584*	*4.05*
Conway RCo.42/1	B.P.	Ax. × Ax.	7×9	14.6 : 1	365.0	Cann. 10	1×2	20,250	—	—	9,955	0.622	16,500	—	9,575	0.592	N.A.	150.0	48.0	5,001	4.04
Dart RDa.6 Mk. 510	Tp.	C.	2	5.4 : 1	20.5	7	2	370	1,535	1,670	14,500	0.717	N.A.	1,310	14,000	0.753	N.A.	98.0	38.0	1,106	1.64
Dart RDa.7/2 Mks. 526 and 527	Tp.	C.	2	5.6 : 1	23.5	7	3	505	1,835	2,020	15,000	0.69	N.A.	1,835	15,000	0.69	N.A.	98.0	38.0	1,227	1.65
Dart RDa.10/1 Mk. 542	Tp.	C.	2	6.35 : 1	27.0	7	3	N.A.	2,750	3,030	15,000	N.A.	N.A.	2,305	15,000	0.663	N.A.	98.0	38.0	1,376	2.2
Spey (RB 163-1)	B.P.	Ax. × Ax.	4×12	16.8 : 1	202.0	Cann. 10	2×2	9,850	—	—	12,490	0.56	9,450	—	12,260	0.545	N.A.	110.0	37.0	2,200	4.48
Tyne RTy.11 Mk. 512	Tp.	Ax. × Ax.	6×9	13.5 : 1	46.5	Cann. 10	1×3	N.A.	4,850	5,325	15,250	0.482	N.A.	4,270	14,100	0.488	N.A.	108.7	43.2	2,275	2.34
Tyne RTy.12 Mk. 515	Tp.	Ax. × Ax.	6×9	13.5 : 1	46.5	Cann. 10	1×3	N.A.	5,095	5,500	15,250	0.466	N.A.	4,685	14,500	0.472	N.A.	108.7	43.2	2,177	2.53
U.S.A.																					
Allison																					
Model 501-D13	Tp.	Ax.	14	9.25 : 1	39.0	Cann. 6	4	726	3,460	3,750	13,820	0.54	702	3,094	13,820	0.552	N.A.	145.2	36.0	1,750	2.14
General Electric																					
CF700-1	Tf.	Ax.	8	N.A.	N.A.	Ann.	2	4,000	—	—	N.A.	0.69	3,770	—	N.A.	0.69	N.A.	64.0	34.0	615	6.50
CJ610	Tj.	Ax.	8	*7.0 : 1*	*42.5*	Ann.	2	2,850	—	—	N.A.	0.99	2,700	—	N.A.	0.97	39.7	N.A.	17.7	355	N.A.
CJ805-3	Tj.	Ax.	17	12.0 : 1	167.1	Cann. 10	3	11,200	—	—	7,680	0.806	9,500	—	N.A.	0.738	109.6	188.94	31.6	2,800	4.0
CJ805-23A	Tf.	Ax.	17	13.0 : 1	167.1	Cann. 10	3	16,100	—	—	7,680	0.541	13,700	—	N.A.	0.505	N.A.	144.0	53.0	3,825	4.21
CT58-100	S.T.	Ax.	10	8.3 : 1	12.4	Ann.	2×1	N.A.	1,050	N.A.	26,300	0.64	N.A.	900	19,500	0.67	55.0	71.0	27.3	280	3.75
Pratt & Whitney																					
JT3C-6	Tj.	Ax. × Ax.	9×7	13.0 : 1	180.0	Cann. 8	1×2	13,500*w*	—	—	8,000	0.90	10,000	—	N.A.	0.77	138.64	167.53	38.88	4,234	3.19
JT3C-7	Tj.	Ax. × Ax.	9×7	13.0 : 1	180.0	Cann. 8	1×2	12,000	—	—	8,000	0.785	10,000	—	N.A.	0.77	136.78	167.53	38.88	3,495	3.43
JT3C-12	Tj.	Ax. × Ax.	9×7	13.0 : 1	N.A.	Cann. 8	1×2	13,000	—	—	8,000	0.820	10,500	—	N.A.	0.78	136.78	167.53	38.88	3,550	3.66
JT3D-1	Tf.	Ax. × Ax.	8×7	13.0 : 1	N.A.	Cann. 8	1×3	17,000	—	—	8,200	0.52	14,500	—	N.A.	0.505	145.0	N.A.	53.0	4,065	4.18
JT3D-3	Tf.	Ax. × Ax.	8×7	13.0 : 1	N.A.	Cann. 8	1×3	18,000	—	—	8,200	0.535	16,400	—	N.A.	0.515	136.32	N.A.	53.0	4,170	4.32
JT3D-5	Tf.	Ax. × Ax.	8×7	N.A.	N.A.	Cann. 8	1×3	20,000	—	—	N.A.	0.595	18,000	—	N.A.	0.535	136.32	N.A.	53.0	4,490	4.45
JT4A-3	Tj.	Ax. × Ax.	8×7	12.0 : 1	300.0	Cann. 8	1×2	15,800	—	—	8,000	0.78	12,500	—	N.A.	0.74	144.12	—	43.0	5,020	3.15
JT4A-9	Tj.	Ax. × Ax.	8×7	12.0 : 1	300.0	Cann. 8	1×2	16,800	—	—	N.A.	0.81	13,500	—	N.A.	0.75	144.12	N.A.	43.0	5,050	3.33
JT4A-11	Tj.	Ax. × Ax.	8×7	12.0 : 1	300.0	Cann. 8	1×2	17,500	—	—	N.A.	0.84	14,900	—	N.A.	0.77	144.12	N.A.	43.0	5,100	3.43
JT8D-1	Tf.	Ax. × Ax.	13 total	N.A.	N.A.	9	4 total	14,000	—	—	N.A.	0.64	12,600	—	N.A.	0.585	N.A.	119.9	44.0	2,980	4.70
JT12A-6	Tj.	Ax.	9	6.5 : 1	N.A.	Cann. 8	2	3,000	—	—	N.A.	0.96	2,400	—	N.A.	0.895	N.A.	77.9	21.9	436	6.88
U.S.S.R.																					
Ivchenko																					
AI-20	Tp.	Ax.	10	N.A.	N.A.	Ann.	3	N.A.	N.A.	4,015	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
AI-? (used in An-24)	Tp.	Ax.	N.A.	N.A.	N.A.	Ann.	N.A.	N.A.	2,000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Kuznetsov																					
NK-12M	Tp.	Ax.	14	13.0 : 1	137.0	Cann.	5	2,645	12,000	N.A.	9,250	0.573	N.A.	N.A.	N.A.	N.A.	N.A.	236.2	45.3	*5,070*	N.A.
Mikulin-Zubets																					
AM-3M (RD-3M)	Tj.	Ax.	8	N.A.	N.A.	Cann.	2	19,180	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	*200.0*	*54.0*	*5,100*	N.A.

Note.—Data in italics are estimated or unofficial. Abbreviations.—Ann., annular; Ax. axial; B.P., by-pass engine; C., centrifugal; Cann., cannular; N.A., not available; S.T., shaft-turbine engine; Tf., turbofan; Tj., turbojet; Tp., turboprop, * lb. thrust, s.h.p. or e.h.p. as applicable; *a*, e.h.p.; *p*, with propeller; *w*, with water injection.



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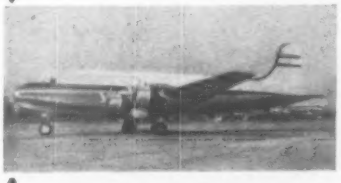

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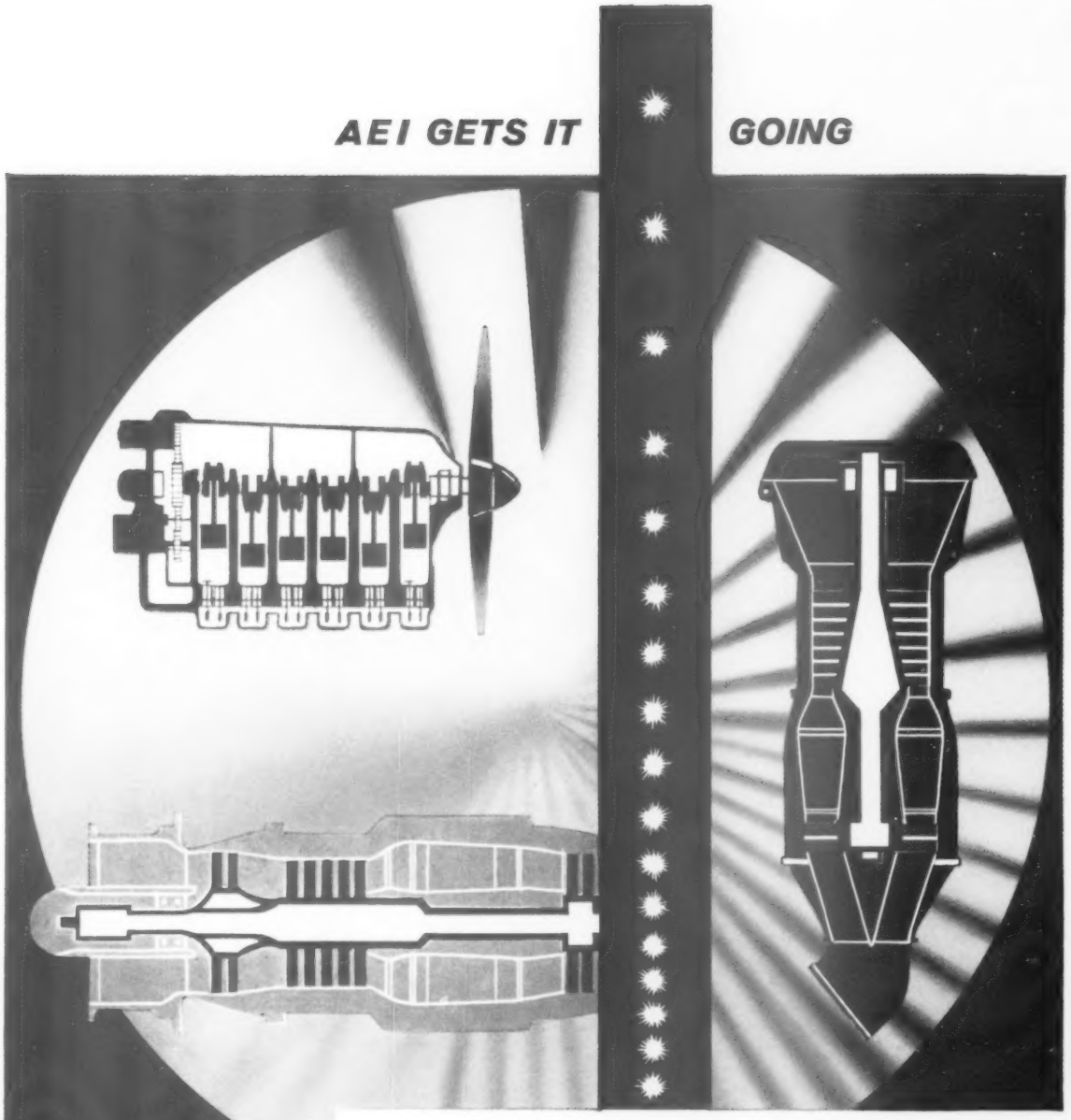

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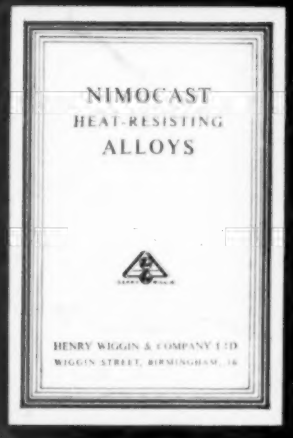

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